Vol. 66, No. 3 May, 1959

Psychological Review

RICHARD L. SOLOMON, Editor
Harvard University

CONTENTS

Stimulus Variables and Subject Variables: A Caution.....GEORGE MANDLER 145

Subjective Probability and Decision Under Uncertainty.....N. T. FEATHER 150

The Nature and Origins of Psychological Sexual Identity.....THOMAS COLLEY 165

That Confounded System Performance Measure—A Demonstration....F. V. TAYLOR AND H. P. BIRMINGHAM 178

The Effect of Emotion on Cue Utilization and the Organization of Behavior.....J. A. EASTERBROOK 183

PUBLISHED BIMONTHLY BY THE
AMERICAN PSYCHOLOGICAL ASSOCIATION, INC.

Editorial Consultants

JEROME S. BRUNER
BYRON A. CAMPBELL
RAYMOND B. CATTELL
IRVIN L. CHILD
WARD EDWARDS
WILLIAM K. ESTES
PAUL M. FITTS
EUGENE GALANTER
DAVIS HOWES
J. MCV. HUNT
FRANCIS IRWIN
GEORGE A. KELLY
HERBERT KELMAN
GREGORY A. KIMBLE
FRANK A. LOGAN
R. DUNCAN LUCE
ELEANOR E. MACCOBY
GEORGE MANDLER
DAVID C. MCCLELLAND
PAUL E. MEEHL
GEORGE A. MILLER
FREDERICK MOSTELLER
MARTIN T. ORNE
LEO J. POSTMAN
VICTOR RAIMY
EDGAR H. SCHEIN
HAROLD SCHLOSBERG
JOHN P. SEWARD
KARL U. SMITH
JOHN P. SPIEGEL
SAUL H. STERNBERG
RENATO TAGIURI
JOHN W. THIBAUT
WARREN S. TORGERSON
BENTON J. UNDERWOOD
HANS WALLACH

(A large group of psychologists has kindly agreed to assist in the editing of manuscripts submitted to the *Psychological Review*. In each issue the Editor will list in the *Review* those editorial consultants who have helped him process manuscripts for that issue, so that their efforts may be gratefully acknowledged.)

The *Psychological Review* is devoted to articles of theoretical significance to any area of scientific endeavor in psychology. Except for occasional articles solicited by the Editor, manuscripts exceeding 7,500 words will not be accepted. Ordinarily manuscripts which consist primarily of original reports of research should be submitted to other journals. However, reports of original research may be included in a major theoretical article which attempts to integrate several related original studies.

Because of the large number of manuscripts submitted, there is an inevitable publication lag of several months. Authors may avoid this delay if they are prepared to pay the costs of publishing their own articles; the appearance of articles by other contributors is not thereby delayed.

Tables, footnotes, and references should appear on separate pages; all of these, as well as the text, should be typed double-spaced throughout, in all manuscripts submitted.

All manuscripts must be submitted in duplicate.

Original figures are prepared for publication; duplicate figures may be photographic or pencil-drawn copies. Authors should retain a copy of the manuscript, in case there is loss in the mail. Manuscripts should be addressed to the Editor, Richard L. Solomon, Emerson Hall, Harvard University, Cambridge 38, Mass.

ARTHUR C. HOFFMAN, Managing Editor; HELEN ORR, Promotion Manager; HERBERT NELL, Editorial Assistant

PUBLISHED BIMONTHLY BY THE
AMERICAN PSYCHOLOGICAL ASSOCIATION, INC.
Prince and Lemon Streets, Lancaster, Pa.
1333 Sixteenth St. N. W., Washington 6, D. C.

$8.00 volume $1.50 issue

Second-class postage paid at Lancaster, Pa.

Send all communications, including address changes, to 1333 Sixteenth St. N.W., Washington 6, D. C. Address changes must arrive by the 10th of the month to take effect the following month. Undelivered copies resulting from address changes will not be replaced; subscribers should notify the post office that they will guarantee second-class forwarding postage. Other claims for undelivered copies must be made within four months of publication.

© 1959 by the American Psychological Association, Inc.

VOL. 66, NO. 3 MAY, 1959

THE PSYCHOLOGICAL REVIEW

STIMULUS VARIABLES AND SUBJECT VARIABLES: A CAUTION[1]

GEORGE MANDLER

Harvard University

Contemporary psychological research concerns itself in a vast number of cases with the covariation of two variables. Whether we are interested in the relation between hours of deprivation and speed of running in the rat, between the physical properties of a stimulus and its subjective scaling, or between rigidity and authoritarianism, the relationships sought are usually in the covariational form. We shall demonstrate here that such covariations are not adequately defined without an additional specification or restriction. The classical dichotomies, such as "experimental" vs. "observational" designs or "manipulated" vs. "naturalistic" variables, fail to specify one important distinction—that between variables associated with individuals or subjects and variables associated with situations or stimuli.

In general, we may distinguish among three types of two-variable relationships: the classical experimental design, research on individual differences or subject sampling, and situational or stimulus sampling.

[1] This paper was prepared in connection with a research project supported by the Foundation's Fund for Research in Psychiatry and by Grant M-2442 from the U. S. Public Health Service. The author would like to thank Frederick Mosteller and Jean M. Mandler for valuable criticisms and suggestions.

In the classical experimental design, a sample of organisms, explicitly or implicitly said to be representative of the population of subjects to which we would like to generalize, is exposed to an antecedent situation (the independent variable) and its consequent behavior is measured (the dependent variable). No other variables do, or should, operate in a systematic fashion in this kind of design. We need not enter into an argument here about the relative advisability of research with single organisms vs. groups of organisms; the basic argument and logic are the same.

In much of the research on individual differences or subject sampling, we are concerned with a quite different problem. A group of subjects, again presumably representative of some parent population, is used to obtain individual measures on two or more variables. The variables used are aimed at a variety of theoretical goals, but in general it may be said that they measure some genetic or experimental, some natural or nurtural characteristic of organisms. The general design is the same whether subjects are measured individually, or whether they are divided into groups, e.g., in the study of the learning ability of high and of low anxious groups.

Finally, in situational or stimulus

sampling the subjects are subjected to a variety of different stimulus or environmental situations, and the relationship of two or more variables across these different situations is of interest.[2] Thus, we may ask whether nonsense syllables with high association values also show high familiarity indices. In this kind of technique, sampling of relevant stimuli is difficult, since frequently the parent population is not, or even cannot, be specified. Psychologists, while frequently concerned with the taxonomy of individuals, have shown little interest in a taxonomy of situations (cf. Brunswik, 1956). Cattell (1957) has made theoretical and empirical advances toward such a taxonomy which is essential for a meaningful interpretation of some situational designs.

The primary concern here will be with the last two kinds of designs. The argument to be presented is concerned with the need to specify the type of population, subjects or stimuli, when describing two-variable relationships. Factor-analytic studies have long been concerned with these distinctions, and the two designs described are related to variations of R technique and P technique, respectively (Cattell, 1952). Other investigators, however, have frequently reported relationships between variables, without specifying the kinds of instances (subjects or situations) for which these relationships are presumed to hold. The composition of the sample is, of course, usually specified. What is often missing, however, is the explicit recognition that the use of a particular variable has been restricted to stimuli or subjects. We shall see presently that these two kinds of covariations may, even within the same research design, yield independent and radically different results.

A distinction between covariations within groups and within the units constituting these groups is related to our caution, and certainly is not new to investigators of social phenomena. Thorndike (1939) pointed out that:

> If the correlation between two traits, A and B (say, poverty and delinquency) in n groups (say, the residents of w districts) has a certain value, K, the correlation between A and B in the individuals or the families composing the groups need not be K and will not be, save in very special circumstances. . . . And it is to be feared that many readers with little knowledge of correlations often misapply correlations between features of states, counties, cities, wards, classes, etc. to their constituent units. (p. 122.)

In order to illustrate the inadequacy of simply describing the relationship between two variables without further restriction, we shall consider a schematic example and two research findings.

In Table 1 a fictitious matrix of research results is presented. It deals with a design in which 5 subjects (S1 to S5) have been tested in 5 different situations (E1 to E5). For simplicity's sake we may assume that the order of presentation of the five situations has been randomized or counterbalanced so that no serial effects systematically influence our data. For each subject we obtain two measures (A and B) in each situation. By summing rows and columns of A and B values, we then obtain a mean or median A and B value for each subject across the situations, and a mean or median A and B value for each situation across subjects. Our imaginary data have been arranged in such a way that rank order correlations for the variables A and B yield a rho of $+1.00$ for subjects and of -1.00 for situations. In other words, any description of these findings which merely talks about a posi-

[2] Similar to this design is the sampling of measures across sequential points in time (or trials).

TABLE 1

A FICTITIOUS MATRIX OF VALUES FOR TWO VARIABLES (A AND B) ON FIVE SUBJECTS (S) IN FIVE SITUATIONS (E)

		E1		E2		E3		E4		E5		Median	
		A	B	A	B	A	B	A	B	A	B	A	B
S1	A	1		2		3		4		5		3	
	B		5		4		3		2		1		3
S2	A	2		3		4		5		6		4	
	B		6		5		4		3		2		4
S3	A	3		4		5		6		7		5	
	B		7		6		5		4		3		5
S4	A	4		5		6		7		8		6	
	B		8		7		6		5		4		6
S5	A	5		6		7		8		9		7	
	B		9		8		7		6		5		7
Median	A	3		4		5		6		7			
	B		7		6		5		4		3		

tive or negative relationship between the two variables is meaningless. Meaningful use of these findings requires specification of the population of instances, thus describing a positive relationship for the subject sampling design, or a negative relationship for the stimulus sampling design.

A somewhat different problem which arises from a matrix such as is presented in Table 1 is the problem of prediction. Neither of the two correlations by itself provides the best predictive index if we were asked to predict a single subject's value on B, given his A value in a particular situation. Our major interest here, however, is in the different kinds of relationship between two "variables" which may be obtained in different designs. The kind of matrix shown in Table 1 is rarely available in typical psychological research; rather, one or the other type of relationship is reported. What should be quite clear at this point is that the two relationships (across subjects and across situations) are not functionally dependent; they may, as we have seen, be quite different.

Some characteristics of the kind of matrix illustrated in Table 1 may be briefly discussed. Each single cell (subject-situation interaction) may be considered as a separate population of values generated by a subject in a particular situation. The values shown in our matrix are then only a single sample from this population. Whenever the two variables, A and B, show the same characteristics in all such cells, then all the correlations obtainable from the matrix will be identical. In other words, if the means, variances, and covariances of the As and Bs are identical in all cells, then both marginal correlations as well as the over-all correlation index for the matrix will be the same. Furthermore, it appears that differences in the marginal correlations depend on different means and variances within the cells, rather

than on variations among the correlations within cells.[3]

Turning from our fictitious example, we can now briefly discuss two recent research findings which illustrate the importance of our caution.

In a replication of a recent study on verbal behavior (Mandler & Parnes, 1957), 32 *S*s were presented with 20 stimuli ranging from nonsense syllables to Rorschach cards. Each *S* was instructed to give to each stimulus all the single word associations which that stimulus evoked. Two measures are of interest here: the number of associations (F) elicited and the relative frequency of idiosyncratic associations (I%), i.e., associations given to a particular stimulus by one and no other subject. In order to describe the relationship between frequency (F) and idiosyncrasy (I%), two correlations were obtained: (*a*) the correlation between the total number of associations given by each *S* to all 20 stimuli and the percentage of those associations which were idiosyncratic; (*b*) the correlation between the total number of associations elicited by each stimulus from all 32 *S*s and the percentage of those associations which were idiosyncratic. In the former case (the subject sampling design), the correlation between F and I% is + .440; in the latter case (the stimulus sampling design), the correlation is − .692.

In another study, we have been concerned with the relationship between physiological and verbal indices of reactions to disturbing material. Thirty-two *S*s were presented with 18 phrases from Heath's Phrase Association Test (Heath, 1956). For each subject-phrase unit we obtain an index of disturbance (D) based on the verbal association to the phrase and the magnitude of the change in skin conductance corrected for base level (PGR). Here again two correlations between D and PGR result. The correlation between the *S*s' mean disturbance score and mean PGR change is − .529; that between the mean disturbance score and mean conductance change elicited by each phrase is + .303.

For illustrative purposes, some plausible explanations of these two findings can be considered. For example, in the case of verbal frequency and idiosyncrasy, individuals who give many associations tend to exhaust the common vocabulary and become idiosyncratic, while stimulus objects which elicit many associations are probably more familiar and elicit few idiosyncratic associations. In the second set of findings, some such notion as the alternate or substitutive expression of disturbance in verbal and physiological systems of individual subjects may be relevant for the negative correlation, while the positive relationship for phrases may be related to an activation explanation. What is clearly evident from these findings is that the disturbance index of a phrase, the PGR elicited by a phrase, the frequency of associations elicited by a stimulus, or the idiosyncrasy of those associations are quite different measures than when these "variables" are attributed to a subject.

Similarly, questions as to the description of the "proper" or "real" relationship between these pairs of variables, or the relative interest of the subject or stimulus correlation are vacuous. What must be kept in mind is that we are dealing here with *different* variables. This difference resides in both operational considerations, i.e., in ways in which the measures are obtained, and in conceptual

[3] Abelson (1958) has recently drawn attention to the general case of three-way data tables (as in our matrix). He has suggested the use of discriminant function in their analysis, paying particular attention to the kinds of differences that may be of interest to various investigators.

considerations, i.e., the relationship between the variable and other terms. The choice of the variable to use will, as always, be determined by theory—the kind of question we want to ask of our data. Clearly a theory which talks about individual differences in conductance changes may be different from a theory which talks about the effect of various stimulus dimensions on conductance changes. This difference in theoretical considerations looms particularly large if we consider the position of these two types of variables within the antecedent-consequent relationship. In the situational design we may manipulate the antecedent conditions which give rise to a variation in the variable of interest; in the subject design we obtain values of the variable of interest, but the antecedent conditions which have given rise to these particular values may, in fact, vary considerably from subject to subject. In the latter case we cannot infer identical arousal or antecedent conditions, whereas in the former we can manipulate or control these conditions.

The classical experimental design has not been explicitly compared with the two correlational designs examined here. In this kind of design it is usually quite clear that we are dealing with stimulus variables, i.e., variations in manipulations and conditions. However, these "experimental" variables should not be uncritically equated with similar variables appearing in a subject sampling design. It is quite apparent that designs which relate an independent and a dependent variable, e.g., drive (deprivation) and performance, may be using different variables in our sense than those where the measurement of one of the variables, e.g., drive, depends on some experiential history of the *S*s (the subject sampling design). Thus, studies of the effect of shock or induced anxiety on performance may be subject to a different conceptual interpretation than those which investigate the differential performance of *S*s of high and low anxiety.

Similarly, the distinction made here also applies to studies in which we might be interested in the relation between perceptual accuracy and emotional response to stimuli. A stimulus (e.g., an emotionally loaded word) which arouses "perceptual defenses" is different from a "perceptually defensive" subject. Another relevant caution might be entered against a comparison of child-rearing variables and adult characteristics when it is based on variations across social classes (the stimulus design) as against variations in individual subjects.

These few examples illustrate the importance of specifying *fully* the operational and conceptual function of a variable. A joint specification of the instrument and the population of instances over which the variable operates seems imperative on the basis of the considerations presented here.

REFERENCES

ABELSON, R. P. A discriminant approach to factoring three-way data tables. *Amer. Psychologist*, 1958, **13**, 375.

BRUNSWIK, E. *Perception and the representative design of psychological experiments.* Berkeley: Univer. California Press, 1956.

CATTELL, R. B. *Factor analysis.* New York: Harper, 1952.

CATTELL, R. B. *Personality and motivation structure and measurement.* Yonkers-on-Hudson, N. Y.: World Book, 1957.

HEATH, D. Individual anxiety thresholds and their effect on intellectual performance. *J. abnorm. soc. Psychol.*, 1956, **52**, 403–408.

MANDLER, G., & PARNES, ELIZABETH W. Frequency and idiosyncracy of associative responses. *J. abnorm. soc. Psychol.*, 1957, **55**, 58–65.

THORNDIKE, E. L. On the fallacy of imputing the correlation found for groups to the individuals or smaller groups composing them. *Am. J. Psychol.*, 1939, **52**, 122–124.

(Received November 12, 1958)

Psychological Review
Vol. 66, No. 3, 1959

SUBJECTIVE PROBABILITY AND DECISION UNDER UNCERTAINTY

N. T. FEATHER[1]

University of New England, Australia

In this paper it is intended to review generally five approaches which relate to the analysis of behavior in a choice situation where a decision is made between alternatives having different subjective probabilities of attainment. The present discussion is mainly concerned with the way in which the concept of subjective probability has been incorporated into each model.

The five contributions to be reviewed are: (*a*) the Lewin, Dembo, Festinger, and Sears (1944) analysis of level of aspiration behavior; (*b*) Tolman's (1955) discussion of the principles of performance; (*c*) Rotter's (1954) basic equation in his social learning theory; (*d*) Edwards' (1954, 1955) discussion of the SEU model from decision theory; and (*e*) Atkinson's (1957) risk-taking model.

The remarkable fact about these five approaches is their similarity with respect to concepts employed and equations advanced. Recently Siegel (1957) has noted the close similarity between the level of aspiration analysis by Lewin et al. (based on the earlier work of Escalona [1940] and Festinger [1942b]) and the SEU decision model. The *first* main aim of this paper is to show that the parallel may be taken further to include the analyses by Tolman, Rotter, and Atkinson. This parallel is all the more interesting and significant in that these models have developed from different areas of research. Lewin et al. are concerned with goal-setting in the level of aspiration situation, Tolman's analysis is related to animal experimentation, Rotter's social learning theory is applied to clinical problems, the Edwards SEU model relates to research in decision theory, and Atkinson is concerned with the effect on risk-taking behavior of individual differences in motive strength. It would appear, then, that interpretations of research from diverse areas are converging upon a similar type of model.

Despite this parallel, however, there is a discrepancy in the way in which subjective probability is included in the different analyses. The *second* main aim of this paper is to bring this discrepancy to light. The discrepancy concerns whether or not concepts which are akin to utility in the various models are taken to be *independent* of subjective probability. In other words, are utilities, valences, reinforcement values, and similar concepts related to subjective probability in these models, or are they assumed to be independent? It will be argued that this question can be approached experimentally, and an experimental study (Feather, in press) testing hypotheses, derived from assumptions about the effects of past learning on behavior in choice situations, will be outlined in an attempt to resolve some of the disagreement.

The Five Analyses

Lewin et al.

The Lewin et al. analysis[2] of level of aspiration behavior involves the

[1] Now on leave at the University of Michigan.

[2] This model is in some respects similar to Cartwright and Festinger's (1943) theo-

concepts of force, valence, and subjective probability. The positive valence of future success Va $(Suc\ A^n)$ at Level n, as it appears to the subject when he sets his goal, is positively related to the expected difficulty of attaining that level. Further, the negative valence of future failure Va $(Fai\ A^n)$ at Level n is inversely related to the expected difficulty. However, since the subject is dealing with future success and failure, Lewin et al. consider also the probabilities of occurrence of these events. In accordance with Lewin's (1943) general approach, these are subjective and two such probabilities are distinguished, the subjective probability of success $Prob.$ $(Suc\ A^n)$ at Level n, and the subjective probability of failure $Prob.$ $(Fai\ A^n)$ at Level n. The subjective probability of success is inversely related to difficulty, while the relationship of the subjective probability of failure to difficulty level is direct. Thus, in the model, the positive valence of future success decreases with increase in the subjective probability of success, and, likewise, the negative valence of future failure decreases with increase in the subjective probability of failure; i.e., valences and subjective probabilities are *inversely* related.

The choice of a particular level is assumed to be determined by a combination of these valences and subjective probabilities. Lewin et al. postulate a weighted valence of success $^{\circ}Va$ $(Suc\ A^n)$ at Level n as a multiplicative function of the valence and subjective probability of success at that level:

$$^{\circ}Va\ (Suc\ A^n) = Va\ (Suc\ A^n).\ Prob.\ (Suc\ A^n)$$

Similarly, the weighted valence of failure $^{\circ}Va$ $(Fai\ A^n)$ at Level n is given by:

$$^{\circ}Va\ (Fai\ A^n) = Va\ (Fai\ A^n).\ Prob.\ (Fai\ A^n)$$

Driving forces are coordinated to each of these weighted valences, and it is assumed that Level n will be selected if the resultant weighted valence at that level is a maximum. This model is used to interpret many of the results from level of aspiration studies.

Tolman

Tolman (1955) discusses the question of how his assumed cognitive and motivational variables issue into actual behavior. He sets out principles which are concerned with molar acts identifiable by observing responses in more than one concrete test situation. Specifically, he discusses a hungry rat's performance of lever pressing in a Skinner box, in terms of the following variables: the need-push for food (n_f), the positive valence of expected food (v_f), the expectation of food (exp_f), the need-push against work (n_{-w}), the negative valence of the expected work (v_{-w}), and the expectation of work (exp_w).

These variables are related to the performance vector (Pv) in the following equation:

$$Pv = f_x(n_f, v_f, exp_f) - f_y(n_{-w}, v_{-w}, exp_w)$$

The functions f_x and f_y are left unspecified, but Tolman suggests that it is possible that they might be multiplicative. The equation is applied to discussion of some basic types of animal experimentation, including discrimination in a simple choice situation. Tolman does not consider in his paper the possibility that, in some situations, there may be relationships between valences and expectations.

retical account of decision time which involves the concept of restraining forces and random fluctuation of subjective magnitudes around a mean value.

Rotter

Rotter indicates that the emphasis in his social learning theory ". . . is on performance, on the selection of alternative behaviors, rather than on the acquisition of responses or on early conditioning of physiological reflex behavior" (1954, pp. 80–81). His is an expectancy-reinforcement point of view involving the concepts of behavior potential, expectancy, and reinforcement value. The approach is essentially molar and shows the influence of Tolman and Lewin.

Behavior potential is determined from the behavior actually occurring when the individual makes a choice, and measures are relative so that in any situation where alternatives are present, it is possible to order behavior potentials according to their strength. Rotter's expectancy refers to a probability held by the individual, which can nevertheless be objectively measured (see, for example, Rotter, Fitzgerald, & Joyce, 1954). Reinforcement value is determined from a choice situation where expectancy is held constant for the alternatives present.

The three concepts are related in Rotter's fundamental equation:

$$B.P._{x, s_1, R_a} = f(E_{x, R_a, s_1} \,\&\, R.V._a)$$

which is read as follows: "The potential for behavior x to occur in situation 1 in relation to reinforcement a is a function of the occurrence of reinforcement a following behavior x in situation 1 and the value of reinforcement a" (1954, p. 108). Rotter is careful to avoid any precise mathematical formulation, but it is clear from his discussion (1954, pp. 108–109) that he favors a multiplicative relationship. He extends his fundamental equation to cover sets of reinforcements, behaviors, and situations, but the essential relationship is maintained.

It should be noted that reinforcement value and expectancy are held, in general, to be *independent* and may be related only under specific conditions. This is in contrast to the inverse relationship between valence and subjective probability in the Lewin et al. analysis.

Edwards' SEU Model

In recent years a considerable body of literature concerning the theory of decision has appeared, much of it influenced by von Neumann and Morgenstern's (1944) book, *Theory of Games and Economic Behavior*. Edwards (1954) has reviewed this literature, and in a later article (1955) he argues on the basis of his research into probability preferences (1953) that a comprehensive model for risky choice would include both the concepts of utility and subjective probability.

Edwards discusses a model which asserts that people choose so as to maximize subjectively expected utility (SEU). This is expressed (1955, p. 201) in the following equation:

$$\text{SEU} = \sum_i p_i^* u_i$$

where p_i^* refers to the subjective probability corresponding to the objective probability of the ith outcome, and u_i is the utility or subjective value. Similar models have been presented by Ramsey (1931), Savage (1954), and by Coombs and Beardslee (1954).

It should be noted that utility and subjective probability are generally considered to be independent in SEU models. Thus Edwards writes: "If utilities and subjective probabilities are not independent, then there is no hope of predicting risky decisions unless their law of combination is known, and it seems difficult to design an experiment to discover that law of combination" (1954, p. 400). This line is

also taken by Coombs and Beardslee (1954, p. 263) in their assumption that utility of prize and utility of stake are independent of psychological probability. In this respect these models appear to be closer to Rotter's approach, which, we have seen, provides a similar independence assumption concerning reinforcement value and expectancy.

Atkinson

Atkinson's (1957) analysis of risk-taking behavior may be considered as an extension of the Lewin et al. resultant valence theory of level of aspiration. This model involves six variables: The subjective probability (i.e., expectancy) of success (P_s), the subjective probability of failure (P_f), the incentive value of success (I_s), the negative incentive value of failure (I_f), the achievement motive (M_s), and the motive to avoid failure (M_f). The subjective probabilities refer to situationally aroused expectancies in the person concerning the probability of the consequences of instrumental acts. Positive incentives refer to potential rewards and goals, negative incentives to potential punishments and threats, both types of incentive being experimentally manipulable. Motives are conceived as dispositions within the person to approach certain classes of positive incentives or to avoid certain classes of negative incentives. The general method of inferring strength of motive is through content analysis of thematic apperception (Atkinson, 1958).

It will be noted that the model differs from the Lewin et al. theory in giving motives and incentive values independent status. However, Atkinson suggests that the valence or utility of an incentive may be considered as a function of strength of motive and incentive value (1958, pp. 303–304).

Specific assumptions are made concerning the incentive values of success and failure. The incentive value of success (I_s) is taken as the complementary of the subjective probability of success (P_s), i.e., $I_s = 1 - P_s$. Further, the negative incentive value of failure (I_f) is taken as $-P_s$. In short, incentive values and subjective probabilities are inversely and linearly related.

The variables are combined multiplicatively in the following equation:

$$\text{Resultant Motivation} = (M_s \times P_s \times I_s) + (M_f \times P_f \times -I_f)$$

Predictions are made from this model concerning the effects of individual differences in the strength of achievement motive and motive to avoid failure, on both level of performance and risk-taking. Atkinson (1957) reports experiments which are consistent with these predictions.

Summary and Discussion

It is apparent that the above five approaches are generally similar in the concepts they employ and the equations which they advance. In each of them a "resultant force" is related to a maximized combination of "valence" and "subjective probability" factors. The basic type of relationship for each is summarized in Table 1.

This table shows that similar types of equations are being advanced from five different areas and suggests that it might be possible to effect some integration, perhaps by combining the mathematical sophistication of decision theory with some of the experimental insights from the other areas.

It is also apparent, however, that there appears to be a discrepancy in the way subjective probability has been incorporated into these models. The basis of this discrepancy is expressed

TABLE 1

CONCEPTS IN FIVE THEORETICAL STATEMENTS RELATED TO THE VARIABLES SUBJECTIVE PROBABILITY, ATTAINMENT ATTRACTIVENESS, AND CHOICE POTENTIAL

Theorist	Concepts	Resultant
Lewin et al.	subjective probability × valence	force (weighted valence)
Tolman	expectation, need-push, valence	performance vector
Rotter	expectancy and reinforcement value	behavior potential
Edwards	subjective probability × utility	SEU
Atkinson	expectancy × (motive × incentive value)	resultant motivation

in the question: Are valences, reinforcement values, and utilities independent of subjective probability? If they are not independent, then the prediction of decision under uncertainty becomes a complex matter. As we have seen, Lewin et al. answer this question in the affirmative and assume an inverse relationship between valence and subjective probability, Atkinson likewise relates incentive value inversely to subjective probability, Tolman does not consider the question, Rotter argues that his concepts of reinforcement value and expectancy are in general independent, while Edwards, and Coombs and Beardslee, assume independence between utility and subjective probability.

It is, of course, quite feasible that, if utility type concepts are independent of subjective probability, this independence might be confined to particular types of situation and activity. Decision theorists usually begin by defining these concepts as independent and, in their experiments, attempt to deal with situations and activities where this assumption may be justified. We would argue, however, that a more comprehensive theory of decision would also consider situations and activities where this assumption might not be reasonable, and would in addition set out a theoretical basis for independence or otherwise. While it is quite legitimate to make the assumption of independence and to see where it leads in terms of prediction from the decision model, there is point to the question of *when* the assumption should be made, the clarification of the conditions under which it might or might not be reasonable, and the theoretical basis for the judgment.

An experimental approach to this problem has recently been made by Feather (in press) in a study of the effect of varying subjective probability of attainment in a decision situation involving different goal objects. No attempt is made to provide a sophisticated mathematical analysis. Instead, the hypotheses are related to rather general assumptions which stress the effects of past learning experiences on the present decision, for different types of situation.

DEFINITIONS, ASSUMPTIONS, HYPOTHESES

Three concepts, *attainment attractiveness, choice potential,* and *success probability,* are defined as follows:

1. Given a number of goal objects A,B,C . . . the attainment attractiveness of A > attainment attractiveness of B > . . . if, in a situation in which *S* is required to express his wishes with respect to attainment, and in the absence of any commitment to the choice, he states that he would prefer to get A, rather than to get B . . .

2. Given a number of goal objects A,B,C, . . . the choice potential associated with A > choice potential associated with B > . . . if, in a situation in which there is the implication that *S* is committed to his choice, he chooses to get A, rather than B . . .

3. The success probability associated with a goal object refers to the probability held by *S* that a particular goal object may be obtained.

Thus attainment attractiveness is defined by a situation where *S* merely expresses wishes concerning which goal object he would *like to get*[3] the most, whereas the definition of choice potential involves a situation where he decides which particular goal object he would *try for*. Success probability obviously corresponds to the subjective probabilities of Lewin et al., Atkinson, Edwards, Coombs and Beardslee, and also to Tolman and Rotter's expectancy. Attainment attractiveness corresponds to the concepts of valence, reinforcement value, and utility; choice potential to the concepts of force, resultant motivation, performance vector, behavior potential, and SEU.

The following assumptions are involved in the hypotheses of the investigation:

1. It is assumed that the attainment attractiveness of a goal object may be related not only to its attractiveness qua object but also to the value which *S* places on its *achievement;* his wishes reflect both the attractiveness of the object for him and the extent to which he values achieving it.

2. It is assumed that, in general, *S* places greater value on the attainment of a goal object when it is difficult to get than when it is easy to get. In our culture it is common to praise the successful achievement of a difficult goal, while failure to attain an easy goal is often deprecated and is, in some cases, punished. With the relatively consistent occurrence of these rewards and punishments, one might expect that *S* will come to develop achievement values which vary with difficulty level as assumed.

3. It is assumed that the value placed on the attainment of a difficult goal object is *greater* in: (*a*) ego-related than in chance-related situations;[4] (*b*) achievement-oriented than in relaxed situations.[5] Again it is possible to consider general learning experiences in our culture. In some situations, achieving the difficult is praised more than in others, and, conversely, failing to achieve the easy is punished more in some situations than in others. Thus one might expect that *S* will come to learn to relate his achievement values to the situation. Specifically, he should tend to value achieving the difficult more in a situation in which he can obviously ascribe success to his own efforts or skill (ego-related) than in one where success may be seen as mainly due to chance factors beyond his control (chance-related); and more in a situation which is structured as a test, involving considerable pressure towards doing well (achievement-oriented), than in one

[3] It should be noted that the definition refers to the attractiveness of *attaining* a goal object rather than to the attractiveness of a goal object. This is in contrast to the variable studied in many of the object preference studies (Filer, 1952; Irwin, Armitt, & Simon, 1943; Wright, 1937), but is clearly similar to the positive valence of success in the Lewin et al. analysis.

[4] This is in line with the distinction made by Filer (1952) between merit and non-merit conditions in a study of factors affecting the attractiveness of goal objects, and a distinction made by Phares (1957) between skill and chance situations.

[5] This is in line with distinctions made by McClelland, Atkinson, Clark, and Lowell (1953) and Atkinson (1954) in investigations of the achievement motive.

which is structured as a game with little pressure towards high achievement (relaxed).

4. It is assumed that the choice potential associated with a goal object may be related to those factors assumed to underly its attainment attractiveness and, in addition, to the *constraining effect*[6] on choice in a commitment situation, of the success probability associated with the goal object. This assumption considers the effect of background learning experiences in past decision situations which differ in the way in which the choice is structured. In a decision situation which implies that S is committed to his choice and may have to act upon it, an important consideration in making the decision is the *possibility of failure and loss*,[7] a factor not present when a wishful choice is elicited. It may be argued that in the past the attempt to achieve the unlikely in these situations has often led to failure and consequent loss of the goal object, whereas choice of the easy has usually led to success. As a result of these experiences, one might expect the development of a tendency to choose the easy rather than the difficult in a commitment type of choice situation, i.e., low success probability should tend to constrain or oppose committed choice, channelling choice in the direction of the easy. But here also, it is necessary to consider the role of achievement values and their relation to situational context. It may happen, for example, that in situations which are highly achievement-oriented and ego-related, the value placed on the difficult achievement is the dominant factor in the decision, and hence committed choice is in line with S's wishes.

In terms of these assumptions the following two hypotheses are advanced:

Hypothesis 1. The attainment attractiveness of a goal object should tend to vary *inversely* with the associated success probability. This assumed co-variation should tend to be *more* apparent in (*a*) ego-related than in chance-related situations and (*b*) achievement-oriented than in relaxed situations.

Hypothesis 2. The choice potential associated with a goal object should tend to vary *directly* with the associated success probability. This assumed co-variation should tend to be *less* apparent in (*a*) ego-related than in chance-related situations and (*b*) achievement-oriented than in relaxed situations.

Hypothesis 1 proposes that as a goal object becomes *less* likely for S he should tend to wish to get it *more* and that this increase in attainment attractiveness should be more apparent in ego-related and achievement-oriented situations where higher value is placed on the difficult achievement. It is apparent that the investigation of this hypothesis may help to elucidate the question of whether or not concepts of the utility type are related to subjective probability and, if so, under

[6] This constraining effect of subjective probability is apparent in the models discussed. It is also apparent in an experiment conducted by Mosteller, Bush, and Goodnow and reported in Bush and Mosteller (1955, pp. 294–296). They contrasted a gambling situation in which losses were subtracted from the final score with one in which losses were overlooked and only wins were counted. They found that subjects in the former situation moved more rapidly and more completely to a concentration of choices on the more probable alternative.

[7] One might also include as a factor the negative value or repulsiveness of failure per se apart from loss of the goal object (Lewin et al., Atkinson). In situations where goal objects are low in value and have little interest for the subjects, one might expect this "failure repulsiveness" to affect the committed choice. It is assumed, however, that in the experimental situation to be discussed this is not a salient factor, the important thing being the possibility of loss of the goal object.

what conditions. There is no statement of independence in Hypothesis 1, but it should be noted that the inverse relationship between attainment attractiveness and success probability has limits imposed upon it according to situational conditions. Thus it is predicted that *S* should wish to get a difficult goal object more in a situation which is test-like in nature than in one which is structured as a game, and more in a situation where he can ascribe success to his own skill than in one in which success is obviously a chance phenomenon. It might in fact happen that where a situation is relaxed and success is chance-related, there may be little evidence of the presence of achievement values related to difficulty, and the inverse relationship might not occur. Here, then, an independence assumption would be justified. The general theoretical basis for Hypothesis 1 is contained in the first three assumptions.

Hypothesis 2 proposes that as a goal object becomes *less* likely for *S*, there should be *less* tendency for him to choose it even though achievement of it is more highly valued. It is, however, possible that the direct relationship may not be apparent under ego-related and achievement-oriented conditions because of the relatively higher value placed on achievement of the difficult in these situations. Here committed choice might mirror *S*'s wishes. All four assumptions are involved in this hypothesis.

AN EXPERIMENTAL STUDY

More detailed description of experimental procedure is presented in another report (Feather, in press). The variables were incorporated into a $2 \times 2 \times 2$ factorial design, and 24 boy *S*s sampled from New South Wales Primary Schools were randomly assigned to each of the eight groups. Testing was individual.

Five different candies were used as goal objects in the procedure. These were selected on the basis of pilot research so as to be similar in attractiveness and were presented to each *S* in a paired-comparison arrangement, the 10 different pairs being presented successively. One candy in each pair was easier to get than the other, the difference in subjective probability being related to different task requirements, T_1 and T_2.

*S*s in the ego-related situation were first required to sort a deck of 36 cards into 3 trays for 6 trials, and for each trial a fictitious prearranged time score was reported. Similar sequences of times were used for all *S*s in this situation in order to allow them the same opportunity of arriving at an estimate of their ability on what to them was a novel task. Following the 6 trials, the 10 pairs of candies were presented successively and for each pair the success probability associated with each candy was determined by implying that attainment would be contingent upon sorting the cards in a specified time. Thus, "Suppose you were actually trying to get one of these, and that you would get it only if you could sort the cards within a certain time. . . . If you decided to try for this one, you would get it only if you sorted the cards within 41 sec. (T_1). If you tried for this one, you would get it only if you sorted the cards within 46 sec. (T_2). So this packet is an *easy* one to get, this one is a *hard* one to get." This, then, is the sort of situation in which success can obviously be ascribed by *S* to his own skill.

The *S*s tested under chance-related conditions were shown a lottery box containing 15 red marbles and 5 blue marbles. One of the marbles could

be rolled through a gate at the bottom of the box. The 10 pairs of candies were presented successively and for each pair the success probability associated with each candy was determined by implying that attainment would depend upon rolling out a marble of a particular color. Thus, "If you decided to try for this one you would get it only if you rolled a blue marble out of the box (T_1). If you tried for this one you would get it only if you rolled a red marble out of the box (T_2)." In contrast to the above, this is the sort of situation in which success can be seen by S as largely a matter of chance.

Under achievement-oriented conditions, card-sorting was introduced as a test of speed and the lottery box as a test of luck. In the relaxed situation, card-sorting was introduced as a game played with cards and the lottery box as a marble game.

The S was required to make his selection from each pair of candies in accordance with the dependent variable studied. For attainment attractiveness, the question was: "Now if you were to get one of these, which one would you feel most pleased about getting? Which one do you *wish* you could get the most?" For choice potential, the question was: "Which one would you actually *choose* to try to get . . .?" The S was not, however, required to act upon his choice. The Ss were also asked to give a reason for each selection made.

Using an extended χ^2 analysis (Sutcliffe, 1957), it was possible to compare the proportion of times a candy was selected when it was easy to get as against when it was difficult to get for each dependent variable over the different situational conditions.

Later all Ss were tested individually under *actual* choice conditions with the same pair of candies being used throughout. Instructions were as follows: "I'm going to let you actually try to get one of these today. . . . Which one are you *actually* going to choose to try to get . . .?" It was thus possible to compare an S's selection from this pair in the first or verbal situation with his choice in the second or actual situation, other conditions remaining the same. A binomial test was used to evaluate the significance of changes.

Results and Implications

In general, the results, which are presented with the statistical analysis in detail elsewhere (Feather, in press), confirm both hypotheses. Tables 2 and 3 will serve to indicate the basic type of data analyzed for Hypotheses 1 and 2. Table 2 presents results bearing upon Hypothesis 1 for Candy C.

Table 3 presents results bearing upon Hypothesis 2 for Candy C.

Subject to the scope of this investigation, the major results may be summarized as follows:

1. Where attainment attractiveness is the dependent variable there is, for all situational conditions combined, a significant *decrease* in the proportion of + selections for each of the goal objects as success becomes subjectively more likely (i.e., less of a tendency to wish to get the candy, as it becomes easier to get). This supports Hypothesis 1.

2. Where choice potential is the dependent variable there is, for all situational conditions combined, a significant *increase* in the proportion of + selections for each of the goal objects as success becomes subjectively more likely (i.e., more of a tendency to choose to get the candy, as it becomes easier to get). This supports Hypothesis 2.

3. These results are in turn related

TABLE 2

FREQUENCIES OF SELECTION (+) AND NONSELECTION (−) OF CANDY C FOR ALL EXPERIMENTAL CONDITIONS (HYPOTHESIS 1)

Condition	Choices		Total
	Selected (+)	Not Selected (−)	
Ego, Achievement, T_2	5	43	48
Ego, Achievement, T_1	42	6	48
Ego, Relaxed, T_2	16	32	48
Ego, Relaxed, T_1	30	18	48
Chance, Achievement, T_2	9	39	48
Chance, Achievement, T_1	31	17	48
Chance, Relaxed, T_2	25	23	48
Chance, Relaxed, T_1	27	21	48
Totals	185	199	384

Note.—Table 2 is to be read as follows: In the ego-related, achievement-oriented situation Candy C is selected 5 times and rejected 43 times in the 48 pairs in which its attainment depends upon satisfying the performance requirement T_2 (sorting the cards within 46 or 47 sec.) and when attainment attractiveness is the dependent variable.

to situational context, differences in relationships between situations being generally in line with prediction. Thus, for example, the decrease in the proportion of + selections for each of the goal objects, with increase in success probability when attainment attractiveness is the dependent variable, is greater under achievement-oriented conditions than under relaxed conditions, and

TABLE 3

FREQUENCIES OF SELECTION (+) AND NONSELECTION (−) OF CANDY C FOR ALL EXPERIMENTAL CONDITIONS (HYPOTHESIS 2)

Condition	Choices		Total
	Selected (+)	Not Selected (−)	
Ego, Achievement, T_2	17	31	48
Ego, Achievement, T_1	31	17	48
Ego, Relaxed, T_2	38	10	48
Ego, Relaxed, T_1	12	36	48
Chance, Achievement, T_2	23	25	48
Chance, Achievement, T_1	31	17	48
Chance, Relaxed, T_2	35	13	48
Chance, Relaxed, T_1	9	39	48
Totals	196	188	384

Note.—Table 3 is to be read as follows: In the ego-related, achievement-oriented situation Candy C is selected 17 times and rejected 31 times in the 48 pairs in which its attainment depends upon satisfying performance requirement T_2 (sorting the cards within 46 or 47 sec.) and when choice potential is the dependent variable.

greater for the ego-related situation than for the chance-related situation. However, it is interesting to note that when the frequency data bearing on Hypothesis 1 are considered separately for the chance-related, relaxed situation alone, there is little evidence for an inverse relationship between attainment attractiveness and success probability; i.e., it appears that the independence assumption might be justified here. Further, under achievement-oriented conditions, the relationship between choice potential and success probability swings to inverse; i.e., there is an *increase* in the proportion of + choices of a candy with decrease in success probability. It appears that achievement values are particularly important factors for both wishful and committed choice under these testlike conditions.[8]

4. Subjects, in giving their reasons for selection, indicate the importance for them of the attractiveness of the object, achievement values, and the constraint of success probability as factors affecting their decisions in the different situations. The reasons given are in agreement with the assumptions involved in the hypotheses. For example, wishing to get the difficult is most often explained in terms of "wanting to do well," etc., i.e., by reference to achievement values, while choosing to get the easy is generally explained in terms of the probability factor, e.g., "You've got more chance of getting it."

5. The constraining effect of success probability on choice behavior in a commitment situation becomes particularly apparent where the choice is *actual*, i.e., where the person is, in fact, required to act upon his choice. Situations can vary in the degree to which they imply commitment; an actual situation seems to show to best advantage the role of success probability as a constraint on choice behavior.

These results appear to have the following implications with respect to the role of subjective probability in decision under uncertainty:

1. It is suggested that it is important to define clearly the *meaning* of success for a person in a decision situation where alternatives of different subjective probabilities are presented. This study has indicated that achievement values related to difficulty level may have an effect on the decision, and the evidence supports a fairly general inverse relationship between attainment attractiveness and success probability. This is consistent with the inverse relationship assumed by Lewin et al. between positive valence of success and subjective probability, and with Atkinson's assumption of an inverse relationship between incentive value of achievement and subjective probability. It does not agree, however, with the independence assumptions of Rotter, Edwards, and Coombs and Beardslee. It should be noted that both the Lewin et al. and Atkinson models are related to the level-of-aspiration type of situation where achievement values might be expected to play an important role. In contrast, decision-theoretical models have, to date, been mainly concerned with chance-related situations which may be so structured as to make achievement values related to difficulty relatively unimportant, since personal endeavor cannot effect the external random event on which the outcome depends. Situations in which achieve-

[8] This particular result is of course subject to the goal objects used in this investigation. For goal objects of high value one might expect less of a tendency to choose the difficult under achievement-oriented conditions, since the loss attendant upon failure is greater.

ment or nonachievement of a goal may have personal relevance are, in the language of decision theory, cases of uncertainty rather than risk. These constitute an important class of situations which decision theory will ultimately have to consider; they pose complex and difficult issues requiring detailed analyses and research. It is to be hoped that in time it will be possible to relate decision in these situations to sophisticated and rigorous mathematical models. Recently Drèze (1958) has attempted to extend decision theory in this direction in a theoretical analysis of individual decision making under partially controllable uncertainty.

It should be pointed out, however, that the results of the present study suggest that the independence assumption may in fact be an oversimplification even for chance-related situations (cf. results in Table 2 for chance-related, achievement-oriented conditions), and Atkinson makes the same point when he argues (1957, pp. 370–371) that incentive values may generalize to gambling situations in which winning is really not contingent upon one's own skill and competence. It is also possible that some tasks used in decision studies, while objectively chance-related, may be seen by *S* as involving an element of skill (e.g., the pinball apparatus used by Edwards [1953]), and, further, that achievement values related to difficulty might generalize to them on the basis of past experience. We would therefore question the reasonableness of an independence assumption in some of these studies. As we have noted previously, it would be quite legitimate to assume independence between utility and subjective probability and then see where the decision model leads with respect to agreement of logical prediction and observation. But surely a more comprehensive model would carefully consider the conditions under which an independence assumption may or may not be justified and would present the theoretical rationale and criteria for arriving at the judgment of whether to make the assumption or not.

2. It is suggested that it is important to consider the way in which the decision is structured, particularly the degree to which it involves commitment. The results have shown important differences in relationships involving subjective probability, according to whether or not a committed choice or a wishful choice is studied. There is further support for this from level-of-aspiration studies (Festinger, 1942a; Irwin & Mintzer, 1942) which have indicated that the type of question asked can affect the response.

3. Finally, it is suggested that it is important to study decision for different situational contexts. The results have shown that there are differences for ego-related *versus* chance-related situations, and for achievement-oriented *versus* relaxed situations. Thus, for example, the results indicate that the direct relationship between choice potential and success probability which occurs under relaxed conditions swings to inverse in the achievement-oriented situation; i.e., in this type of situation, committed choice tends to be in line with the *S*'s wishes. We have considered these differences in terms of situational effects on achievement values, but there is a further possibility to consider here, namely, a possible situational effect on subjective probability which would affect the decision. Under achievement-oriented conditions, for example, there may be a tendency to overestimate probabilities. Lewin et al. write as follows: "... the various parts of the life-space are an interdependent field . . . the expectancy or reality level of the psychological future is also

affected by the wish and fear (irreality) level of the psychological future" (1944, p. 367). Related to this are investigations by Marks (1951), Irwin (1953), Crandall, Solomon, and Kellaway (1955), and Worell (1956) which have studied whether stated expectations are influenced by the value of anticipated events. Atkinson (1957) discusses the possible biasing effect of achievement motive and motive to avoid failure, on subjective probabilities.

Further, it is possible that a person's attitude towards probability might vary across ego-related and chance-related situations. It might happen, for example, that an individual tends to judge probability as more "dependable" in the former type of situation. Phares (1957) has found that a chance situation produces smaller expectancy changes than a skill situation, since in a chance situation scores may provide little basis for generalization to future trials. Goodnow (1955) has shown that the task set is an important condition in her studies of probability matching, "all-or-none" behavior in predicting occurring more frequently in a gambling task than in a task presented as a problem to be solved. All of these studies indicate the importance of considering the relationship of decision to different situational contexts and suggest that the basis for these relationships may be complex.

The above discussion underlines the complexity of the decision process and is consistent with the general emphasis in this paper on the need to consider the context of past experience as an important influence. Decisions made now are to some extent continuous with those made previously, and the recognition and analysis of this background may lead to a better understanding of the role of subjective probability in decision under uncertainty.

SUMMARY

This paper is concerned with the way in which the concept of subjective probability has been incorporated into five approaches which relate to decision under uncertainty, viz. the analysis of level of aspiration behavior by Lewin et al., Tolman's principles of performance, Rotter's fundamental equation in his social learning theory, the Edwards SEU model in decision theory, and Atkinson's risk-taking model. These approaches are shown to be similar with respect to the concepts employed and the equations advanced. A discrepancy is noted in the relationship of valence, reinforcement value, and utility to subjective probability.

In an attempt to clarify this relationship, the concepts of attainment attractiveness, choice potential, and sucess probability are defined. Attainment attractiveness is defined in terms of a wishful choice relating to attainment in a situation free from commitment; choice potential is defined by a choice in a situation where there is implied commitment. Success probability refers to the probability held by the person concerning successful attainment. In terms of these concepts, two hypotheses are advanced. Assumptions involved in these hypotheses emphasize the effect on decision of past learning experiences, particularly in wishful choice and committed choice situations, and the influence of relatively common cultural achievement values related to success probability, which are also in part a function of situational context. It is predicted that attainment attractiveness should tend to be inversely related to success probability and that choice potential should tend to be directly related to success

probability. The hypotheses also consider differences in these relationships for ego-related as against chance-related situations, and achievement-oriented as against relaxed situations. An experimental study is outlined whose results generally support these hypotheses.

Some implications of this study for decision under uncertainty are considered: (*a*) the importance of considering achievement values as possible factors in the decision, (*b*) the need to consider the way in which the decision is structured (whether it involves a statement of wishes in the absence of commitment or a choice where commitment is implied or actual), and (*c*) the importance of studying decision behavior in different types of situation, in line with the assumed variation in achievement values for different situations and the possible effect of situational contexts on judgments of probability.

REFERENCES

ATKINSON, J. W. Exploration using imaginative thought to assess the strength of human motives. In M. R. Jones (Ed.), *Nebraska symposium on motivation.* Univer. Nebraska Press, 1954. Pp. 56–112.

ATKINSON, J. W. Motivational determinants of risk-taking behavior. *Psychol. Rev.*, 1957, **64**, 359–372.

ATKINSON, J. W. (Ed.) *Motives in fantasy, action, and society.* Princeton: Van Nostrand, 1958.

BUSH, R. R., & MOSTELLER, F. *Stochastic models for learning.* New York: Wiley, 1955.

CARTWRIGHT, D., & FESTINGER, L. A quantitative theory of decision. *Psychol. Rev.*, 1943, **50**, 595–622.

COOMBS, C. H., & BEARDSLEE, D. On decision-making under uncertainty. In R. M. Thrall, C. H. Coombs, & R. L. Davis (Eds.), *Decision processes.* New York: Wiley, 1954. Pp. 255–258.

CRANDALL, V. J., SOLOMON, D., & KELLAWAY, R. Expectancy statements and decision times as functions of objective probabilities and reinforcement values. *J. Pers.*, 1955, **24**, 192–203.

DRÈZE, J. H. Individual decision making under partially controllable uncertainty. Unpublished doctoral dissertation, Columbia Univer., 1948.

EDWARDS, W. Probability-preferences in gambling. *Amer. J. Psychol.*, 1953, **66**, 349–364.

EDWARDS, W. The theory of decision making. *Psychol. Bull.*, 1954, **51**, 380–417.

EDWARDS, W. The prediction of decisions among bets. *J. exp. Psychol.*, 1955, **50**, 201–214.

ESCALONA, SYBILLE K. The effect of success and failure upon the level of aspiration and behavior in manic-depressive psychoses. *Univer. Ia. Stud. Child Welf.*, 1940, **16** (3), 199–302.

FEATHER, N. T. Success probability and choice behavior. Unpublished master's dissertation, Univer. of New England, 1958.

FEATHER, N. T. Success probability and choice behavior. *J. exp. Psychol.*, in press.

FESTINGER, L. Wish, expectation and group standards as factors influencing the level of aspiration. *J. abnorm. soc. Psychol.*, 1942, **37**, 184–200. (a)

FESTINGER, L. A theoretical interpretation of shifts in level of aspiration. *Psychol. Rev.*, 1942, **49**, 235–250. (b)

FILER, R. J. Frustration, satisfaction and other factors affecting the attractiveness of goal objects. *J. abnorm. soc. Psychol.*, 1952, **47**, 203–212.

GOODNOW, JACQUELINE J. Determinants of choice-distribution in two choice situations. *Amer. J. Psychol.*, 1955, **58**, 106–117.

IRWIN, F. W. Stated expectations as functions of probability and desirability of outcomes. *J. Pers.*, 1953, **21**, 329–334.

IRWIN, F. W., ARMITT, F. M., & SIMON, C. W. Studies in object-preferences: I. The effect of temporal proximity. *J. exp. Psychol.*, 1943, **33**, 64–72.

IRWIN, F. W., & MINTZER, M. G. Effects of differences in instruction and motivation upon measures of the level of aspiration. *Amer. J. Psychol.*, 1942, **55**, 400–406.

LEWIN, K. Defining the "field at a given time." *Psychol. Rev.*, 1943, **50**, 292–310.

LEWIN, K., DEMBO, TAMARA, FESTINGER, L., & SEARS, P. S. Level of aspiration. In J. McV. Hunt (Ed.), *Personality and the behavior disorders.* New York: Ronald Press, 1944. Pp. 333–378.

MCCLELLAND, D. C., ATKINSON, J. W.,

CLARK, R. A., & LOWELL, E. L. *The achievement motive.* New York: Appleton-Century-Crofts, 1953.

MARKS, ROSE W. The effect of probability, desirability, and "privilege" on the stated expectations of children. *J. Pers.*, 1951, **19**, 332–351.

PHARES, E. J. Expectancy changes in skill and chance situations. *J. abnorm. soc. Psychol.*, 1957, **54**, 339–342.

RAMSEY, F. P. Truth and probability. In F. P. Ramsey, *The foundations of mathematics and other logical essays.* New York: Harcourt Brace, 1931.

ROTTER, J. B. *Social learning and clinical psychology.* New York: Prentice-Hall, 1954.

ROTTER, J. B., FITZGERALD, B. J., & JOYCE, J. N. A comparison of some objective measures of expectancy. *J. abnorm. soc. Psychol.*, 1954, **49**, 111–114.

SAVAGE, L. J. *The foundations of statistics.* New York: Wiley, 1954.

SIEGEL, S. Level of aspiration and decision making. *Psychol. Rev.*, 1957, **64**, 253–262.

SUTCLIFFE, J. P. A general method of analysis of frequency data for multiple classification designs. *Psychol. Bull.*, 1957, **54**, 134–137.

TOLMAN, E. C. Principles of performance. *Psychol. Rev.*, 1955, **62**, 315–326.

VON NEUMAN, J., & MORGENSTERN, O. *Theory of games and economic behavior.* Princeton: Princeton Univer. Press, 1944.

WORELL, L. The effect of goal value upon expectancy. *J. abnorm. soc. Psychol.*, 1956, **53**, 48–53.

WRIGHT, H. F. The influence of barriers upon strength of motivation. *Contr. psychol. Theor.*, 1937, **1**, No. 3.

(Received August 6, 1958)

Psychological Review
Vol. 66, No. 3, 1959

THE NATURE AND ORIGINS OF PSYCHOLOGICAL SEXUAL IDENTITY

THOMAS COLLEY

Central State Hospital, Lakeland, Kentucky

Persons do not exist; there are only male persons and female persons—biologically, sociologically, and psychologically. This is a fact which, in everyday life, is as evident and important to the Australian aborigine as it is to the professional psychologist. The psychologist, however, often ignores this while acting in his professional capacity—especially when designing experiments or developing theoretical systems. Nevertheless, there is no human identity uncomplicated by sexual identity. Personality evolves as either masculine or feminine, or as some combination of the two.

Despite the obvious importance of the area of sexual identity for understanding personality, there has been very limited progress in theory of sexual identity since the formulations of Sigmund Freud.

The purpose of this paper is to advance a theoretical explanation of the nature and origins of *psychological* sexual identity, which will use a more contemporary language than other theory in this area and will achieve better integration with modern methods and knowledge. It relates to modern trends of psychological thinking in its emphasis upon interactional interpersonal relations, the self, and what is presently being called "person perception."

Theory in Sexual Identity

It does not seem necessary to review here the various theories of "psychosexual development" and sexual identity;[1] however, a few comments will be appropriate.

Modern psychology is in debt to Sigmund Freud for his forceful assertion that there was, despite what one might like to believe, something of a sexual nature in the parent-child relationship. Also, he saw implications in this relationship which were of importance in explaining the evolution in the child, and later in the adult, of personality characteristics and disorders.

This driving, formative force that he saw in operation was not restricted to the ignorant, weak, or "wicked" persons, but seemed present in the history of the development of every person. Freud then faced the task of explaining the causes of this sexual, and in his day reprehensible, relationship. If there was something sexual going on between parent and child, the child had to be responsible for it. Likewise, if every child had these "base" desires, the forces behind their origin had to be beyond the control of either parent or child. The most suitable explanation available to Freud at that time was that what he saw in operation was an inborn or basically instinctual phenomenon. By proposing the theory of inborn infantile sexuality and the Oedipus situation, he opened the door to further investigation into the way in which sexual urges modify and are modified by individual personalities and societies.

[1] For a review of different theoretical views of sexual identity and development, see Blum (1953) and Mullahy (1948).

Today, many clinical practitioners take as their theoretical orientation the Freudian theories of "infantile sexuality," "Oedipus complex," and "stages of psychosexual development," either in their original form or in some reformulation (Freud, 1938). This may seem surprising in view of advances made in personality theory since Freud, particularly those made by the "social-psychological" theorists. Freud's thinking, although it forms the basis for so much of modern clinical practice, is only one source to which clinicians may turn for theoretical support.

The work of the cultural anthropologists, notably Margaret Mead (1935, 1949), has exerted a great modifying effect. Further modification has been brought about by the "neo-Freudians," especially Erich Fromm (1941) and Karen Horney (1937). The net effect of these contributions was a shift in emphasis from the inner determinants important in the genesis of personality to the sociocultural or outer determinants.

More recently, in the writings of Carl Rogers (1951), George A. Kelly (1955), and Harry S. Sullivan (1953), the emphasis has begun to swing back toward a position somewhere between these viewpoints, drawing on both, yet adding new meaning. This is the emphasis upon interactional interpersonal relations and the "self" as useful explanatory concepts.

Despite their many merits, these post-Freudian contributions have not found their way with ease into the clinical setting. They have not provided a means of talking and thinking about those aspects of personality which are so important in problems of mental health—sexual interaction and sexual identity. This has left us with the Freudian concepts as often the most practical clinical tools. They have been modified, but age is beginning to show on many of them. It is hoped that the present approach will take the first steps toward providing some newer, more useful concepts in the area of sexual interaction and sexual identity.

Importance of Sexual Identity and Its Discrimination

Most subhuman mammals seem capable from birth or seem quickly to learn ways of discriminating one sex from another within their species. The cues to which they respond are varied, but probably most often involve olfactory and visual perceptual patterns. It is probable that the man animal in its earlier evolutionary stages also relied heavily on such, rather fixed, cues for information as to the gross sexual characteristics of another.

For modern man, however, much more information than odor or appearance is required for comprehensive discrimination of human maleness or femaleness. Human sexual identity is vastly more complex than that of subhuman animals—it does not emerge exclusively from biological origins, and thus it cannot be discriminated on the basis of biological information alone. It is necessary, for example, to know of another not only that he is male, but also what sort of maleness he possesses.

Close interpersonal relations generally involve the interaction of only two persons. For this intimate type of interaction to be meaningful, each person must "identify" the other in certain areas, so that each may respond appropriately to the stimulus the other presents. Probably the most important area for which meaning is sought is that of sexual identity. Unless fairly accurate sexual discrimination is accomplished, interpersonal interaction is likely to be fraught with difficulty and

anxiety. An individual's social adjustment, as well as perpetuation of the species, depends upon accurate discrimination of the sexual identity of others.

SEXUAL IDENTITY

Total Sexual Identity

Although terms such as "identification" and sexual "role" have often been defined, the definition of "sexual identity" has been neglected.

As used here, *sexual identity* refers to *the pattern of positions on the biological, sociological, and psychological continua of the maleness-femaleness dimension which characterizes an individual in relation to others of his sociocultural milieu.* This is *total* sexual identity, and is, therefore, rather unwieldy as a concept. We will need to analyze it into several major components.

Description of an individual's sexual identity requires statements covering at least three important factors: a statement of biological sexual identity, a statement of sociological sexual identity, and a statement of psychological sexual identity.

By biological sexual identity (this shall be called *sexual biomode*) is meant the characteristics of heredity and organic structure and function which distinguish the biologically male from the biologically female. Such organic features as the primary and secondary sex characteristics and the endocrine functions are probably most important here.

Sociological sexual identity (or *sexual sociomode*) applies to such things as gross behavior, dress, interests, attitudes, social standards of beauty and strength, and some personality characteristics, which when taken together constitute what a particular society contributes to the concepts of maleness and femaleness.

Psychological sexual identity (or *sexual psychomode*) is meant to include characteristic ways of perceiving one's sexual interactions with others who are identified as being of the same or of opposite sexual identity.

The separation of total sexual identity into the three "modes" is done for clarity in discussion and economy in theoretical organization and does not imply clear-cut types or independent operation of these variables. The modalities of male and female characteristics are, without doubt, complexly interrelated in any person's sexual identity.

The use here of the suffix "mode" intends a meaning similar to its statistical use as "most typical" or "most frequently occurring." The terms *biomode, sociomode,* and *psychomode* may be used to refer to what is typical for an individual, for the population, or for both. For example, if it is stated that a biomodally and sociomodally male person has inappropriate identity in sexual psychomode, this means that his typical psychological identity is different from that typically occurring among males, but that physically and in social ways he is appropriately male. A person's identity may be inappropriate in one, two, or in all three modes.

It is felt that these three new terms will aid in avoiding the confusion which, in the past, has plagued the use of such blanketing terms as "identification," "psychosexual role," "masculine (or feminine) identity," and others even less precise in meaning.

Psychological Sexual Identity

Description of an individual's sexual psychomode requires statements covering at least two important factors: a

statement indicating the individual's characteristic ways of perceiving his interactions with persons of the same sex; and a statement indicating the individual's characteristic ways of perceiving his interactions with persons of the opposite sex.

Here it is meant that there are relatively enduring patterns of sexually differentiated expectations, largely out of awareness, which a person carries into his interpersonal interactions, and that we must specify the nature of these expectations *for each sex respectively*. If, for example, we know that a male characteristically sees his interactions with other males as being quite sexual in nature—that is, if he sees himself as appropriate for the sexual attentions of other males and sees other males as appropriate for his sexual attentions—this does not necessarily mean that, conversely, he will see females as inappropriate for sexual interaction. We need to know *sexual identity in relation to whom*.

In the present formulations, the emphasis will be on that part of the personality which the writer has called *psychomodal sexual identity*. The theoretical proposals will apply mainly to individual interactions and more or less exclude the contributing factors on the biological or broader sociological levels.[2] Further limitations will be that this formulation will deal with "normal" rather than pathological or deviant trends in psychomodal sexual growth, and that idiosyncratic aspects of sexual identity will be excluded from our present concern.

[2] Margaret Mead, in *Male and Female* (1949), gives careful attention to the effects of sociocultural influences upon sexual identity. Family group influences are evaluated by Talcott Parsons and Robert Bales in *Family: Socialization and Interaction Process* (1955).

THEORY OF SEXUAL IDENTITY

The following postulates are advanced as the preliminary statements of a theory of the origins of psychological sexual identity. Admittedly, they are speculative, but it is hoped that they will prove useful in describing and possibly in understanding sexual identity.

Postulate 1. The sex drive in humans derives originally from biophysical phenomena which the individual is equipped to experience.

By this is meant simply that sex need originally occurs in tissues related to sexual functions and spurs the individual to action. This "spurring" has as its goal the reduction of tension and satisfaction of the need. The resulting behavior may or may not accomplish this goal.

Postulate 2. In humans, reduction of tension and resultant satisfaction of the sexual need may normally be accomplished in a variety of ways.

Here it is assumed that there are, to all practical purposes, neither specific sexual actions (motor response patterns) nor specific sexual objects (perceptual response patterns) that in any organically predetermined way become part of the response repertory of the developing human. Remote biological cues, though they undoubtedly exist in humans, seem to be of little consequence in the discrimination of persons appropriate for sexual interaction, and in the acquisition of ways of achieving sexual satisfaction.

Postulate 3. Patterns of perceptual and motor response which are appropriate for satisfaction of the sexual need, and which are appropriate for psychomodal sexual identity, come to exist in the individual through the process of learning.

This theory of the processes involved in the determination of the psycholog-

ical aspects of sexual identity assumes the occurrence of relatively enduring modification of the individual as a result of experience, and that this modification determines both the manner in which sexual satisfaction is achieved and the nature of psychomodal sexual identity.

At this point we shall have to abandon the topic of sexual satisfaction. The variety of sexually satisfying behavior which has been demonstrated to exist among apparently normal persons suggests that such sexual behavior and sexual identity are not closely interdependent. A discussion of sexual satisfaction is apart from our present aims and its inclusion would clutter our view of sexual identity.

Postulate 4. Psychomodal sexual identity is acquired as a result of interpersonal interaction.

The ability to respond to oneself as an object appropriate for sexually differentiated response from others and the ability to respond to others differentially as to sex are acquired as a direct result of having experienced the response made to one, by at least one other individual.

Postulate 5. The earliest and the most important elements which are part of the unique self are those which derive out of the modalities of maleness and femaleness.

Aside from the facts that it is living, human, and helpless, the next most important observation that parents can make about an infant that will give them a basis for meaningful response to it, is that it is either male or female. Maleness-femaleness is the nearest thing to a dichotomy that man can discern in animate nature—and dichotomies are so satisfying.

When a child is born, parents are quick to reify its sex by adding meaning to the clues nature has provided. Colors, clothing, toys, and name are kept appropriate to the child's sex. The one universal set of *differential* expectations which parents bring to the parent-child interaction is that which is based upon the sexual dichotomy. For a child, this differential coloring of parental response provides the first major data for approximating his position as a unique personality. It is evident to him that there is something that is uniquely his that is consistently influencing the responses others make to him.

It would seem that if we could describe the character of the parents' interpretation of the sexual dichotomy to the child, we would be far better able to predict that child's future sexual identity. Perhaps we would also do a better job of predicting the nature of many of his interpersonal interactions, both sexual and otherwise. We would hope to know what is the meaning of maleness to him, and what is the meaning of femaleness, for it is into this framework that new human experiences are related such that the individual comes to have characteristic ways of seeing and of responding to others. Humans never simply interact; they interact with males and with females.

SEXUAL INTERACTION

Before going further, some definitions will be helpful. As used here, sexual interaction refers to those interactions in which maleness-femaleness is of central importance in shaping the interaction. In daily interpersonal relations, frequently the initial phase is largely a sexual interaction, and thereafter such interactions may reappear in momentary or prolonged fashion.

The term *sexual interaction* is a broad one. It subsumes many intricate behaviors, including those in which physical sexual need is satisfied. In the following discussion, however, the

emphasis will be on "social" sexual interactions which, although potentially capable of it, do not ordinarily lead to physical sexual satisfaction. Opportunities for sexual interaction can occur most readily around emotional or physical experiences, and thus they may be found coincident with such child tending activities as feeding, bathing, elimination, punishment, and play.

Although it can be said that all interpersonal experiences of a newborn infant are in a vague sense sexual interactions, there may be no male-female differentiation to them. At first he is not aware of the differentiation in the responses others make to him, nor does he respond in any sexually selective manner. At that time there is merely an unselective *sexual-emotional approach* response on his part. With time, however, the character of these interactions may become differentiated into two general classes: *prosexual* perceptual response patterns and *antisexual* perceptual response patterns.

By *prosexual* perceptual response is meant the characteristic perception of certain interpersonal situations as appropriate for sexual *approach* behavior.

By *antisexual* perceptual response is meant the characteristic perception of certain interpersonal situations as appropriate for sexual *avoidance* behavior. The term *antisexual* implies more than a mere lack of sexual approach quality in a person's relations with others—it implies the presence of perceptual operations which function to counteract or avoid sexual approach responses which survive from the earlier undifferentiated sexual-emotional approach phase. Much but not all antisexual response will take the *form* of what is presently called hostility. In many instances, however, restrained interaction and "pseudo-hostile" responses denote the presence of antisexuality.

In addition to these two classes, it is expedient to mention a third: the *confused* perceptual response pattern. This will be used to refer to a person whose sexual interactions with others are characterized by ambiguity.

THE NATURE OF APPROPRIATE SEXUAL IDENTITY

The view of sexual interaction just presented provides a sexual approach pattern, a sexual avoidance pattern, and a sexual approach-avoidance conflict pattern. Prosexual perceptual response is appropriate with biomodally opposite sex individuals, whereas antisexuality is appropriate with biomodally same sex individuals. This is the sexual paradigm of nature.

Postulate 6. It is a basic necessary (but not sufficient) condition for appropriate psychomodal sexual identity that a person must bring to his interactions with the biomodally opposite sex the expectation that there should be something prosexual in the nature of these interactions.

Postulate 7. Conversely from Postulate 6 and also necessary (but not sufficient) for appropriate psychomodal sexual identity: a person must bring to his interactions with the biomodally same sex the expectation that there should be something antisexual in the nature of these interactions.

The expectations mentioned in these postulates exist universally in human society as the general rule. Although they are necessary, taken individually, neither is sufficient for appropriate sexual identity. Also, in some cultures it is the males that must be aggressive, while in others it is the females—but these are aspects of the sexual sociomode. Sociomodal characteristics may vary greatly from time to time and place to place; however, our assumed universal expectations should prevail.

As a corollary to Postulates 6 and 7 we may say that, *to the degree that there is lack or disturbance of the expectations stated under Postulates 6 and 7, there will be inappropriate psychomodal sexual identity.* Such difficulty could be due to either failure to acquire appropriate expectations or to the acquisition of expectations which are at a variance with what is appropriate.

In order for a male, for example, to possess adequate psychomodal sexual identity, he must perceive biomodally female persons as *potentially* conducive to the satisfaction of certain needs which are predominantly sexual in nature. He should also view females as persons who expect *of him* the very kind of expectations which he brings to interactions with them. Adequate psychomodal sexual identity implies the seeing of oneself as having prosexual valence for opposite sex persons and no such valence for same sex persons, and it implies the seeing of opposite sex persons as having prosexual valence for oneself, and same sex persons as not having such a valence.

THE ORIGIN OF PSYCHOMODAL SEXUAL IDENTITY

Base in Personality Theory

How does an individual acquire the expectations of appropriate psychomodal sexual identity? In order to answer this question, we must first establish a base in personality theory which will integrate with what we know about social behavior. The ability to respond to oneself as male or as female should come about by the same basic processes by which one comes to have identity in the more general sense of becoming a personality, coming to have a "self."

The theoretical assumption which we shall accept, and which is basic to much of what follows, is that a human comes to have a self—to experience personal identity—only through interpersonal intercommunication, and by learning to call out in himself the same meanings which he calls out in others, through the use of symbols, gestures, and other means of communication, both conscious and unconscious. We incorporate into our own newly forming personality pattern the meanings inherent in the communications of those around us, coming to see ourselves as others see us. Thus the "self" is largely a social product, dependent upon the process of communication for its development. Much that is called personality can be viewed as a result of the meanings and expectations others bring to their interactions with us. Much of personality, then, is a result of "perceptual conforming." [3]

Postulate 8. Psychomodal sexual identity comes about as a result of a process by which the child comes to perceive and respond to itself as it is first perceived and responded to by the significant figures in its early life.[4]

This is the postulate that is basic to our theory, and it will bear elaboration. Calling on the previous postulates, it is possible to assert more clearly that it is not the child who brings to the parent-child interactions the complex of values and expectations related

[3] The theoretical views presented here are somewhat similar to those of H. S. Sullivan (1953), C. H. Cooley (1922), A. N. Whitehead (1929), and particularly G. H. Mead (1934).

[4] Here and elsewhere in this paper, the term "significant figures" is intended to include persons who are sufficiently close to the child for long enough time to be considered parental equivalents; and other, usually older, persons who, although they do not take the place of parents, are nevertheless present for sustained interaction.

to sexuality. Neither is the child able to identify the sex of parent figures, much less to respond to them differentially as to sex. Another way of stating this postulate would be to say that the parent "projects" psychomodal sexual identity into the child—the male parent projecting maleness into male children and femaleness into female children, and the female parent projecting femaleness into female children and maleness into male children. In addition, the parent will contribute something of his own by projecting distortions, personalized interpretations, and other unique perceptions which have become part of his conception of what is appropriate for male with male, male with female, or female with female interaction. These parental perceptual response patterns occur largely outside of awareness.

From the first time a mother looks at her male baby she knows that he is male and her responses will, in many subtle ways, communicate to him that this is how she sees him. The tone of her voice, the way in which she handles him, the special prolonged interest in his developing genitalia, and countless other responses communicate to the male child that his mother is interested in him in a special sort of way. Later he will learn that she is interested in him as she is interested in others who are like him in one very important manner—they are biomodally male.

A mother brings to her male child all the complex of sexual responses which she has learned. The child in turn responds to the mother in a very free, emotionally uninhibited manner. The child may bring some "instinctual" sexual response to the parent-child relationship, but the parent brings a prosexual interest which has been repeatedly frustrated and heightened by social values, taboos, and other socially contributed sex values which have not yet affected the child.

As a male child matures, he is responded to by others, some of whom are similar to mother and some of whom are different and respond to him differently. From the ones similar to mother, he gets recurring patterns of response that are, in many important ways, like that of the mother. From a different sort of figure in his hazy little world, he begins to get response patterns which are very unlike those of the mother. From these, the males, he gets responses which, in some vague way, tell him that he is one who will be in competition with them—that they view him as inappropriate for the kind of emotional treatment that the mother provides. Thus it is that the male child learns the expectations which the two major classes of adult figures have for him. He learns to expect of mother, and thereafter of other females: a flirtatiousness, a seductivity, a teasing sort of approach and withdrawal that says in unspoken language that prosexual interaction is appropriate here. He learns to expect of father, and thereafter of other males: a rivalry, a measure of hostility, a curtailment of mutual emotional interaction that lets him know that something almost the opposite of prosexual interaction is appropriate here.

The generalizations which have been made in the above discussion are very useful ones for a child to make and are necessary for our purposes in explanation. It might appear that when the parental role requires discipline, control, and maintenance of the incest taboo, it tends to contradict these generalizations. In keeping with the present approach, even physical discipline is normally accomplished differentially in relation to sexual identity, and it may even provide an especially fine opportunity for differential paren-

tal response—either during or following a disciplinary interaction.

The incest taboo may be maintained by the setting of limits beyond which prosexual interactions may not go. By gentle rebuffing, a normal mother may tell her son that intense prosexual interaction is not appropriate *now* and *with her,* without irrevocably damaging his prosexual expectations concerning females.

For a female child, there is little difference in the way sexual meaning is conveyed. In the case of a daughter, it is the father who responds seductively. The mother lets her daughter know that prosexual interaction is inappropriate between females and that she views the daughter as a miniature rival for the attentions of males.

The fact that the female child is at first intimately associated with the mother in a need satisfying relationship does not seem to pose a serious problem for her psychomodal sexual identity. From the very first, the mother has been aware that this is a little female and that prosexual interest in her is inappropriate. Also, this little female is physically similar to the mother, and therefore not likely to call forth the special interest in the sexual apparatus and sexual function that the mother has for a male child. Despite the fact that the mother is satisfying certain of the daughter's needs, she is able to make it clear that there is little that is prosexual in this relationship. It is just that discrimination of the sexually seductive ones may come later for the female than for the male child, depending upon how early a father begins to engage in close interaction with a daughter.

Perhaps it will serve the purpose of clarity and emphasis to point out two implications which arise in relation to Postulates 6, 7, and 8.

I. A certain *optimum* of seductive behavior on the part of the opposite sex parent in interaction with the child is necessary for appropriate psychomodal sexual identity to occur.

II. A certain *optimum* of hostile and rivalrous behavior on the part of the parent of the same sex in interaction with the child is necessary for appropriate psychomodal sexual identity to occur.

VARIATION IN PSYCHOMODAL SEXUAL IDENTITY

Psychomodal sexual identity can vary from what is biomodally appropriate as a result of several conditions: insufficient contact with a parent or parents whose psychomodal sexual identity is appropriate; physically the child fails to call out differential parental response; and contact with a parent or parents whose psychomodal identity is in some manner inappropriate.

The *first* condition could come about if a parent is absent either physically or psychologically from the family scene.

It is important to note here that our theoretical plan allows for the total absence—physical or psychological—of one parent without disturbing the child's psychomodal identity, provided there is one appropriately identified parent with whom the child experiences close interaction. One parent may supply sufficient differential response to the child for appropriate identity to occur. Even in a father's absence, an appropriately identified mother will respond to a boy "as if" he were a male and will expect him to treat her as a male would treat a female. When she and her son are together in the presence of other males she will expect of him some competition, hostility, and lack of sexuality

in his relations with the other males regardless of their ages. Her interpretative approval or disapproval of his play with other male children at home, or of incidents he recounts from peer relations when not at home, also serve to let him know what she expects of male with male interactions. *Thus, a child may learn appropriate identity in sexual psychomode in the absence of a parent like himself.*

Most other theory in sexual identity differs from this approach in that it conceives that a child comes to "be" sexually as a result of *identification with* the parent of the same sex, and if this relation is disturbed or lacking, then psychological sexual identity is weakened or blocked. The term "identification" used in that manner requires the presence of a model after whom the child can pattern his behavior. Behavior in imitation of a model is important; however, its main contribution to sexual identity seems to be in the acquisition of appropriate identity in sexual sociomode.

The *second* condition, that of lack of sexual stimulus value on the part of the child, can result from such biomodal factors as lack of physical vigor, gross deviation in physiognomy, or incapacitation of the child due to mental or physical factors. It is possible for only one or for both parents to be affected by conditions such as these.

Although lack of sexual stimulus value on the part of the child can cause difficulties in sexual identity, the presence of too intense sexual stimuli emanating from the child, or projected into the child, can be just as detrimental to sexual adjustment. This situation might result in "over-identity" as a sexual being.

The *third* condition which can result in inappropriate psychomodal sexual identity—contact with a parent whose identity is inappropriate—can best be understood by examining the possible combinations of parental response and by describing the resulting types of psychomodal sexual identity. We shall assume that, in the following descriptions, there are no unusual biomodal or sociomodal circumstances which could influence sexual identity.

Examples of Psychomodal Sexual Identity

By using the three general classes of sexual perceptual response, we may hypothesize nine characteristic patterns of parental response, and thus nine types of psychomodal sexual identity in relation to male and female figures. Table 1 illustrates the possible types of male identity. The letters *P, A,* and *C* designate *prosexual, antisexual,* and *confused* perceptual response, either *from* the parent or *to* another figure. A Type I male, for example, is provided by his father with antisexual (*A*) expectations which he carries into interaction with other male figures. His mother provides him with prosexual (*P*) expectations concerning interactions with females.

The variety of male identities that can occur range from the most appropriate—that in which sexual biomode and psychomode are parallel (Type I)—to the least appropriate—that in which psychomodal sexual identity is inverted in relation to biomode (Type IX). In the latter case we may hypothesize the true psychomodal invert, and, because approach-avoidance confusion is absent, this type may characterize the rare psychologically "adjusted" homosexual.

Between these two types we may hypothesize others in which there is bilateral prosexuality, bilateral antisexuality, bilateral confusion, or some combination involving confusion. A male of Type II, for example, would

have appropriate identity in relation to males, but would experience confusion in relation to females. He may be at ease in interaction with males but quite anxious in interaction with females. The *kind* of maleness he possesses is different from that found in Type III, but the *degree* of inappropriateness is similar.

Types of resultant feminine identity may be described similarly; however, the relations involved would be reversed.

The examples illustrated suggest that a number of predictions are possible, provided we are able to describe the psychomodal sexual identity of the parents. Postdiction of parental identity may be possible if we can determine the character of a person's perceptual responses to male and female figures.

Contact with others who are psychomodally unlike the parents may decrease the accuracy of predictions somewhat. However, it seems reasonable to assume that the early years of close interaction with parent figures largely determine the expectations of sexual psychomode and that these expectations dictate the selection of persons for close interaction. Peers who are very divergent in psychomodal expectations probably exclude each other from close interactions because such interaction would be chaotic or threatening.

It should be clear that the types of identity we have illustrated do not describe degrees of "homosexuality"—they refer to inner psychological sexual identity only. Overt homosexual sex experience does not imply inappropriate psychomodal sexual identity any more than overt heterosexual sex experience implies appropriate identity.

In the theoretical description presented in this paper, one can see a rather different approach to understanding sexual inversion than that proposed by psychoanalytic theory, and it is believed a more predictive one. Fenichel (1945) says of homosexuality, "The homosexual man identifies himself with his frustrating mother in one particular respect: like her he loves men" (p. 331). In keeping with the present approach, it is proposed that the mother of such an inverted male might not love men and might communicate to her son that prosexual interaction with females is inappropriate.

More recently, Erikson (1950) has indicated an orientation which again reflects a prominent difference. Erikson states that the "utopia" of developmental stages, "in a woman, is that ability to partake in and identify with the male's procreative role, which makes woman an understanding companion and a firm guide of sons" (pp. 88–89). The present theory suggests that the understanding companionship and firm guidance of sons should be a paternal contribution and that a mother such as Erikson proposes could easily supply the son with inappropriate expectations regarding women.[5]

TABLE 1

EXAMPLES OF MALE IDENTITY IN SEXUAL PSYCHOMODE

Figure with Whom Interacting	Type of Identity								
	I	II	III	IV	V	VI	VII	VIII	IX
Male	A	A	C	A	P	C	C	P	P
Female	P	C	P	A	P	C	A	C	A

[5] Marked differences between the present approach and that of psychoanalytic theory will be discussed fully in a subsequent publication, and the theory will be extended and applied to problems of hostility and guilt.

BIOMODE AND SOCIOMODE

Any of the "types" of psychomodal sexual identity mentioned can occur in relation to any combination of biomodal and sociomodal identity. For example, a woman may be employed in a profession where "mannish" behavior and dress are desirable, if not necessary. Despite this inappropriate sociomodal sexual identity, she may still be quite feminine psychologically, in sexual psychomode, and physically, in sexual biomode. In like manner, many biomodally deviant males may possess appropriate sociomodal and psychomodal sexual identity.

We may speculate that the three sexual *modes* occasionally interact so as to modify one another. A male who deviates greatly from appropriate biomode and sociomode, whatever the causes, may with time come to develop inappropriate psychomodal identity. Also, a male who is deviant in psychomode and sociomode may with time develop deviations in sexual biomode, such as alteration in endocrine function and the accompanying changes in secondary sex characteristics.

APPLICATIONS

It is beyond the scope of the present paper to make extensive suggestions as to how the theory may be applied; however, several applications and implications deserve mention.

The present approach may provide for earlier and more accurate diagnosis of disturbance in psychomodal sexual identity. Conventional projective tests might be used in such diagnosis, or special instruments may be devised to measure a child's characteristic perception of males and of females.

Once the nature and degree of inappropriateness are determined, it may be possible to provide corrective experience so as to bring about reorganization of perceptual response to self and to others. An implication here is that, in therapy of problems of sexual identity, the *kind* of psychomodal identity possessed by the therapist may be a more important factor than what is talked about or how much "insight" is gained.

Along lines of psychopathology, one might examine the possible relation of certain disorders to certain kinds of psychomodal sexual identity.

SUMMARY

In this paper an attempt has been made to construct a theoretical formulation which will be helpful in understanding and describing the nature and origins of sexual identity. The approach taken is an interactional and interpersonal one.

In the beginning it was indicated that sexual identity can best be understood if it is analyzed into three major components: the *sexual biomode*, the *sexual sociomode*, and the *sexual psychomode*.

It was asserted that to be a person, to have a self, implies the presence of maleness or femaleness—perhaps even depends upon it.

A person's inner or psychomodal sexual identity is held to come about as a result of a person's learning to call out in himself the same response that he calls out in the significant other persons in his early life. Because of the sexual dichotomy, he calls out either *prosexual* or *antisexual* responses in each parental figure.

Emphasis was placed upon the part that *both* parental figures play in responding differentially to the child in terms of sexual identity. The child then carries this differential of expectation into his interactions with others in later life.

It was indicated that different kinds

as well as different degrees of psychomodal sexual identity are possible, and that we must describe the nature of a person's sexual identity in relation to males and in relation to females separately.

REFERENCES

BLUM, G. *Psychoanalytic theories of personality.* New York: McGraw-Hill, 1953.

COOLEY, C. H. *Human nature and the social order.* New York: Scribner, 1922.

ERIKSON, E. H. *Childhood and society.* New York: Norton, 1950.

FENICHEL, O. *The psychoanalytic theory of neurosis.* New York: Norton, 1945.

FREUD, S. *The basic writings of Sigmund Freud.* New York: Modern Library, 1938.

FROMM, E. *Escape from freedom.* New York: Rinehart, 1941.

HORNEY, KAREN. *The neurotic personality of our time.* New York: Norton, 1937.

KELLY, G. *The psychology of personal constructs,* Vol. I. New York: Norton, 1955.

MEAD, G. H. *Mind, self and society.* Chicago: Univer. Chicago Press, 1934.

MEAD, MARGARET. *Sex and temperament in three primitive societies.* New York: Morrow, 1935.

MEAD, MARGARET. *Male and female.* New York: Morrow, 1949.

MULLAHY, P. *Oedipus myth and complex.* New York: Hermitage Press, 1948.

PARSONS, T., & BALES, R. *Family: Socialization and interaction process.* Glencoe, Ill.: Free Press, 1955.

ROGERS, C. *Client centered therapy.* Boston: Houghton Mifflin, 1951.

SULLIVAN, H. S. *The interpersonal theory of psychiatry.* New York: Norton, 1953.

WHITEHEAD, A. N. *Process and reality.* New York: Macmillan, 1929.

(Received September 12, 1958)

Psychological Review
Vol. 66, No. 3, 1959

THAT CONFOUNDED SYSTEM PERFORMANCE MEASURE—A DEMONSTRATION

F. V. TAYLOR AND H. P. BIRMINGHAM

U. S. Naval Research Laboratory

Human-operated aircraft, ships, control centers, and many other operator-controlled military and commercial devices are examples of man-machine systems. So, also, are many laboratory psychomotor tests where men aim, track, toss balls, throw darts, or operate with some other type of physical equipment to achieve performance scores.

Engineering psychologists and others are becoming increasingly interested in system performance per se. This interest has, in part, arisen from the frequent need to evaluate man-machine systems with a view to making them more effective, either through better selection and training of the operators or as a result of design modifications of the nonhuman portions of the system. The practical involvement of psychologists with systems has also led some of them to a concern with systems theory as, more or less, distinct from psychological theory. Both of these interests have brought about the development and use of criteria which reflect the performance of the total system in contrast with that of the individual components. Such measures are proving to be most valuable when the over-all man-machine complex is the object of study.

However, system performance is sometimes also used as a direct measure of the behavior of the man himself. For example, it is a common practice to assess the performance of a human tracker in terms of tracking scores, which are sensitive not only to the subject's behavior, but to that of all other portions of the system as well. Likewise, the number of hits made on a target are often taken as the subject's score, although such a measure reflects the physical and dynamic properties of whatever is thrown or fired and any other equipment used in the process.

When a system measure is used deliberately as an index of human performance with full knowledge of the extent to which the dependent variable is confounded, the practice is certainly justified. Psychologists are, by no means, strangers to complex variables, nor are they unaware of means of dealing with them. However, a danger does exist that in some circumstances the confounding will not be recognized or, when noted, that the extent to which the confounding can distort results will not be appreciated. For this reason, it was felt that a demonstration might be in order to illustrate just how deceptive it could be to infer the behavioral properties of any one component—human or mechanical—from the performance of the total system.

An analogue computer study was, therefore, run off by the authors in which the tracking performance of three "man"-machine systems was compared, using an amplifier—and always the same amplifier—in the place of the man. The choice of this particular electronic component to replace the human was dictated entirely by convenience and not by any idea that the man was, in fact, an amplifier or that he would necessarily act like one in the systems simulated in the computer demonstration. Since, in this analogue study, the specific behavioral charac-

teristics of the human were not a point at issue, it was only necessary to chose a tracking element, the "behavioral" properties of which were completely under control.

The three dynamic configurations chosen for comparison were selected because they could all be stabilized by a simple amplifier, as long as there was no time delay present. They consisted of (*a*) position control (system output always proportional to the output of the tracking amplifier), (*b*) velocity control (system output *velocity* always proportional to tracking amplifier output), and (*c*) quickened velocity control (same as *b*, but with the gain of the velocity term increased, and with the addition that the output of the amplifier was fed back and added to its input) (Birmingham & Taylor, 1954). Computer diagrams of the three configurations are shown in Fig. 1.

Other than the nature of the dynamic configurations, the only independent variable in the test was the gain setting of the amplifier which took the place of the man in all three systems. The same eight values of gain, composing a geometric series extending from 1 to 128, were employed with each of the three configurations. The tracking input was a 3-cycle per minute sine wave. Each system score was obtained by integrating the actual tracking error over a 30-second run.

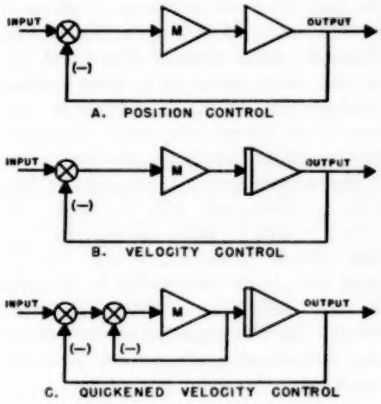

FIG. 1. Computer diagram of the three simulated systems (Amplifier M represents the robot man).

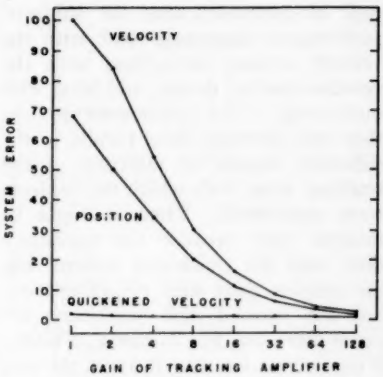

FIG. 2. Performance of the three systems as a function of the gain of the "man" (Linear ordinate).

The results of the demonstration are shown in Fig. 2. In viewing the curves, it is instructive to consider them in the context of actual psychological experiments. First of all, consider the data shown in Fig. 2 as having been obtained in a study of motor skill learning. To do this, it is only necessary to imagine that the three curves represent the performance of different tracking systems when operated by human subjects instead of a single robot, and that the values on the abscissa represent successive periods of practice instead of increasing amplifier gain settings.

Had these results come out of a psychological laboratory—and they are indeed similar to what is actually obtained in studies comparing quickened with other types of tracking systems (Holland & Henson, 1956)—it might

well be concluded that the subjects' performance improved most with the velocity system, next most with the position control device, and least with quickening. One might even go further and attribute these results to the different degrees of difficulty of the tracking tasks with which the subjects were confronted. Thus, it might be inferred that because the operator's task with the quickened system was far simpler than with the other two, less *was* learned with quickening because there was less *to* learn. Finally, if one were a learning theorist, the fact that the velocity control curve was slightly sigmoidal, whereas the others were not, might suggest the conclusion that the velocity tracking skill differed intrinsically from the other two perceptual-motor performances.

But the demonstration may be viewed in still other contexts. By imagining the curves mirror-imaged through being plotted with the abscissa scale reversed, fatigue or vigilance results reminiscent of those reported by Garvey (1957) are simulated. Although Garvey himself did not do so, such system error plots might plausibly be interpreted as indicating that the trackers with the quickened system were less fatigued or more vigilant than those operating the other systems.

Or again, reinterpreting the abscissa values as degrees or variety of stress, one might be tempted to conclude that the performance of trackers using position or velocity control was more subject to disruption than was that of subjects working with a quickened system.

Of course, the point of the study is that all such conclusions may be quite wrong. The demonstration makes it very clear that the behavior of a system component in the position often occupied by a human subject cannot always be directly inferred from the performance of the over-all system. In the present case, the three very dissimilar performance curves all arose from exactly the same "behavioral" changes in the robot man. The amplifier acted in the same way in each system. It "learned," "fatigued," or altered under "stress" by exactly the same amount in all three dynamic configurations.

And if such can be true in this demonstration, it could also occur in the psychological laboratory where human subjects serve in tracking experiments and in other varieties of psychomotor tests. If different man-machine systems produce different performance curves, the latter may be attributable, in whole or in part, to dissimilarities in the manner in which the systems translate and transform the subjects' behavior, rather than to differences in the human behavior itself.

The discrepancy between system scores and human behavior which may enter when the man operates through some kind of a mechanism may arise from three causes. First, the dynamics introduce an arbitrary scale factor which will vary with different dynamic configurations. The same behavior on the part of a subject may result in a system score of 100 with one set of dynamics and a score of 200, 1,000, 50, or any other value in another system arrangement. Second, scale range may vary from system to system. In some man-machine complexes the sensitivity of the system scores to changes in human performance will be high; in others it will be low—so low, in fact, that system performance may be almost completely insensitive to changes in the behavior of the operator. Finally, the configuration of the system may introduce nonlinearities into the relationship between the subjects' behavior and the performance of the system.

These nonlinearities, arising as they

do within the dynamic configuration of the system, are to be distinguished from those intrinsic to certain types of scoring devices (Bahrick, Fitts, & Briggs, 1957). Although the latter may produce the same distortions as those discussed here, it is important to recognize that the nonlinearities issuing from transactions within a system are often unavoidable, since they can result from combinations of completely linear components. In the demonstration described here, for example, all of the electronic elements, including the scoring system, were entirely linear throughout the ranges employed.

The effects of scale factor, scale range, and nonlinearity may be seen in Fig. 3. This graph is a logarithmic plot of the data in Fig. 2. The velocity and position curves differ from one another chiefly in scale factor, since they are nearly identical in range (slope) and in the manner in which they depart from linearity at the low gain end (degree and direction of curvature). However, the quickened velocity curve differs from the other two in all three ways; all values are much lower, the range of scores is much compressed, especially at the higher gains, and nonlinearity between the gain of the tracking amplifier and measured system error is pronounced and opposite in inflection to the other two curves.

The conclusion which emerges from these considerations is that both cross-system and within-system studies are hazardous if the object is to use man-machine system performance as a psychological dependent variable. Only if the transformations contributed by the physical dynamics of the system are known and, when necessary, compensated for in the analysis, can system performance be taken as a veridical indicant of the behavior of the man.

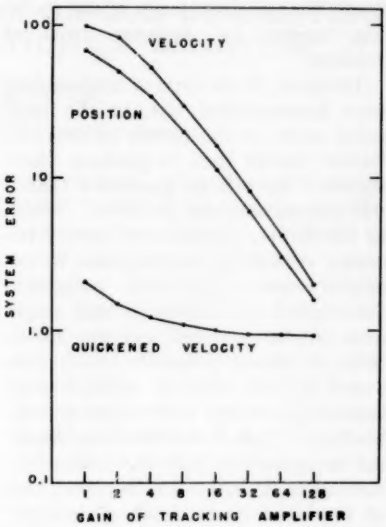

FIG. 3. Performance of the three systems as a function of the gain of the "man" (Logarithmic ordinate).

It is probable that, up to the present, criterion artifacts of the type demonstrated here have acted chiefly in a negative fashion to cause confusion and to water down psychological research findings, rather than to introduce positive misconceptions. Undoubtedly, some of the conflicting results of motor skill experiments on learning, fatigue, vigilance, and response to stress are due to the fact that subjects in different experiments were encapsulated in systems with different scale properties. Also, the identification through factor analysis of fundamental motor skill components is most certainly hampered by the necessity of using a heterogeneous collection of what are, actually, system scores to assess human performance. It is considerably less likely that the utilization of system measures as indicants of human behavior has yet produced a spurious skill factor or

many false positive leads in the learning, fatigue, or vigilance areas of research.

However, if the type of confounding here demonstrated has, in the past, acted more in the nature of research "noise" rather than to produce "false signals," there is no guarantee that it will always continue to do so. When, in the future, psychomotor theory becomes sufficiently sophisticated to entertain more hypotheses containing quantitative predictions, precise measures will be required and the distortions of human response trends produced by all criterion artifacts may become positively and seriously misleading. Then, it will be most essential to appreciate fully the contamination inherent in system measures and to overcome it in "reading through" these measures to the man.

SUMMARY

An analogue computer demonstration is described wherein the performance of three different "man"-machine systems are compared, using an amplifier in the place of the human subject. Although the "behavior" of the robot man was made to change in exactly the same way in all three system configurations, the system performance curves were all very different. This shows clearly that the behavior of a system element cannot always be inferred directly from the performance of a system of which the element is a part. The reasons for this are analyzed and the moral of the demonstration for the study of human motor skills is pointed out.

REFERENCES

BAHRICK, H. P., FITTS, P. M., & BRIGGS, G. E. Learning curves—Facts or artifacts? *Psychol. Bull.*, 1957, **54**, 256–268.

BIRMINGHAM, H. P., & TAYLOR, F. V. A design philosophy for man-machine control systems. *Proc. I.R.E.*, 1954, **42**, 1748–1758.

GARVEY, W. D. The effects of "task-induced stress" on man-machine system performance. *U. S. Naval Res. Lab. Rep.*, 1957, No. 5013.

HOLLAND, J. G., & HENSON, J. B. Transfer of training between quickened and unquickened tracking systems. *J. appl. Psychol.*, 1956, **40**, 362–366.

(Received October 15, 1958)

Psychological Review
Vol. 66, No. 3, 1959

THE EFFECT OF EMOTION ON CUE UTILIZATION AND THE ORGANIZATION OF BEHAVIOR

J. A. EASTERBROOK

Institute of Psychiatry, University of London

The ability to reconcile apparently contradictory facts is the main claim that can be put in urging the adoption of a new concept. It has already been shown how the concept of "range of cue utilization" can account for the different degrees of continuity of learning and for the different amounts of latent learning that have been observed by various workers (Bruner, Matter, & Papanek, 1955). The present paper will attempt to show that a generalization based on this concept can be used to reconcile some of the evidence in the recurrent controversy (Bindra, 1955; Duffy, 1948; Leeper, 1948; Smith, 1958) concerning emotion and the organization of behavior. It is proposed that emotional arousal acts consistently to reduce the range of cues that an organism uses, and that the reduction in range of cue utilization influences action in ways that are either organizing or disorganizing, depending on the behavior concerned.

Recent interest in the range of cue utilization appears to be due to Davis (1948), but it was Bahrick, Fitts, and Rankin (1952) who brought it under deliberate experimental scrutiny, and perhaps Bartlett (1950, 1951) who first used the term "range" in discussing the idea. Tolman (1948) and Bruner, Matter, and Papanek (1955) have treated the concept with reference to breadth of learning. The latter paper provides the most extensive review of pertinent studies on both rats and humans. Callaway and co-workers (1953, 1958) and Combs and Taylor (1952) have introduced similar ideas.

The range of cue utilization is said to have shrunk when the use of peripheral (occasionally or partially relevant) cues has been reduced, although the use of central and immediately relevant cues has been maintained (Bahrick et al., 1952; Bursill, 1958; Davis, 1948; Easterbrook, 1953). Such a change is associated with improvement of central performance or with maintenance of proficiency under stress. The range of cue utilization is said to have fallen when the amount of incidental learning has been reduced although task learning has remained constant or been improved (Aborn, 1953; Bahrick, 1954; Bruner et al., 1955; Johnson, 1952; Kohn, 1954; Silverman, 1954; Silverman & Blitz, 1956). In general, the range of cue utilization is the total number of environmental cues in any situation that an organism observes, maintains an orientation towards, responds to, or associates with a response.

In each of the experiments alluded to in the preceding definition, shrinkage or reduction in the range of cue utilization was found to have been associated with an increase in drive. Accordingly, it is an empirically derived generalization that, when the direction of behavior is constant,[1] increase in drive is associated with a reduction in the range of cue use. This

[1] This condition is required by the facts of the defining experiments. Readers of conflict theory will note that it restricts the discussion to those competitions between stimuli which do not produce stable equilibria (Miller, 1944). The condition does not beg the question unless the term "emotion" be construed as what occurs with vacillation.

paper is devoted to the expansion and exploration of this generalization.

The term "drive," as used in the preceding paragraph and throughout the paper, refers to a dimension of emotional arousal or general covert excitement, the innate response to a state of biological deprivation or noxious stimulation, which underlies or occurs simultaneously with overt action and affects its strength and course. This emotional arousal is greater in neurotic than in normal subjects, greater than usual in subjects under stress or threat or in frustration, and in general greater in animals that have been "motivated" by any of the usual deprivations, noxious stimulations, or other incentives than it is in unmotivated or resting animals of the same species. This appears to be essentially the position Duffy has urged (1948), and bears close similarities to that Spence and co-workers have adopted (e.g., Spence, Farber, & McFann, 1956).

DRIVE AND MOTIVATIONAL CONCENTRATION

When improvement of central performance occurs concomitantly with impairment in effectiveness of peripheral response, as in the experiments cited to define reduction in the range of cue utilization, one may think of terms like "concentration," "focusing," or "sharpening" of action. In each of the defining experiments such "concentration" occurred in association with increased drive. Thus, in Bruner, Matter, and Papanek's experiment (1955), when 36-hr. and 12-hr. food-deprived rats were given equal pretraining on a problem with correlated cues and then trained to use only the less obvious of these cues, the hungriest animals showed the least benefit from the pretraining. They had made fewer observing responses and presumedly therefore had made better use of the plainest cue for the food reward. Johnson (1952) had earlier found that the amount of latent learning displayed depended inversely on the strength of (thirst) drive used in the initial training period. Cues that were not required to gain the reward used in pretraining were evidently not used by the animals with the greater need for that reward. Such concentration is usually attributed to motivation, but whether the effect of added drive was "organizing" or "disturbing" depends on whether the initial or the subsequent problem is regarded as the task.

The phenomenon of motivational concentration is apparent also in studies of human learning (Aborn, 1953; Bahrick, 1954; Kohn, 1954; Silverman, 1954; Silverman & Blitz, 1956) and of perceptual-motor performance (Bahrick et al., 1952; Bursill, 1958; Davis, 1948; Easterbrook, 1953). It is illustrated nicely by the Bahrick, Fitts, and Rankin experiment (1954). The central task was continuous tracking. In addition to this task, subjects were required to report the occurrence of occasional lights on the periphery of the display and to respond to the occasional deflection of a needle on a peripheral dial. Two conditions of motivation were used. When motivation for the central task was presumedly high as a result of the offer of bonuses for high tracking scores, tracking proficiency was superior to that in the low motivation condition —a familiar effect. The interesting finding was that proficiency at the peripheral tasks was inferior under high motivation, despite the fact that they too were more rewarded. As motivation to do well was increased, the range of cue utilization was reduced to the central, to the exclusion of the peripheral, cues. The benefits attributable to motivation were ob-

tained on the central task at the cost of proficiency on the broader (central + peripheral) task. The effect of added drive cannot be described unequivocally as either facilitation or disruption, but it can certainly be described as a reduction in the range of cue utilization.

An almost identical result has been reported by Bursill (1958). In this experiment the subjects were required to keep one pointer superimposed upon another which moved from side to side across a dial. The peripheral task was to respond (by pressing appropriate keys) to the occasional illumination of one of six lights that were arranged in a semicircle between extremes 80° on either side of the central point in the display. Two different air temperatures were provided, one of 60–70° F. and another of 95–105° F. Bursill reports that peripheral signals at greater eccentric angles had a higher probability of being missed in the hotter condition. He describes the event as a "funneling" of the field of awareness and argues that central attentional processes are involved in it because the phenomenon does not occur when the perceptual load on the central task is reduced. Here again proficiency on the narrower task was associated with impairment on the broader, while the range of cue utilization was reduced.

Funneling or focusing is the subject of hypotheses and investigation by at least two other teams of investigators. Callaway and co-workers (1953, 1958) believe that the attentive field tends to become narrower in emotion or under the influence of increased activity in the brain stem reticular formation. One of their experiments will be described below. Combs and Taylor (1952) make their similar hypothesis more specific. Perception of threat to the self is expected to reduce the perceptive field to the area of the perceived threat. Their experiment has conjunctive value for the present discussion because it concerns the relation between range of cue utilization (or breadth of perceptive field) and proficiency in serial tasks.

CUE UTILIZATION IN SERIAL TASKS

Combs and Taylor reasoned that proficiency in a task like the coding subtest of the Terman AA Intelligence Scale would be reduced by a reduction of the perceptive field. They accordingly composed lists of neutral and "threatening" statements to be encoded, the latter including, for example, an offensive remark about mother. Both errors and coding time were significantly greater for the threatening statements, and the authors interpreted this result as support for their hypothesis. However, it is not clear why proficiency in coding should be impaired by a process that is alleged to produce perceptual concentration.

One possible measure of extent of perceptive field is the "range of perceptual anticipation" which Bartlett (1950) has discussed. This range is the amount of perceptual material in a serial array between the point reached by perception and that reached by action in a serial perceptual-motor task. It is reflected in the "receptor-effector span," which is Bartlett's general term for the various spans, such as eye-hand, ear-hand, eye-voice, and others discussed by Woodworth (1938) in the context of copy typing, telegraphic code reception, oral reading, and other serial tasks. An illustrative and historic way of measuring such spans in oral reading is to interrupt the display and count the number of ensuing words that can be spoken (Quantz, 1897). This yields a measure of the amount of text between the point of "intake" and the point of

"output," expressed in convenient units such as words or letters.

The receptor-effector span certainly reflects the extent of utilization of task cues. However, it cannot be identified with the total range until it is clear that no irrelevant cues are being employed at the same time. That is to say, only when the receptor-effector span can be regarded as the maximum for a given subject should it be interpreted as an index of the range of cue utilization or of the breadth of the perceptive field.

Psychological knowledge about the relation between the extent of the receptor-effector span and skill began to be collected before the present century in pioneer studies into the skills of reading (Quantz, 1897), telegraphy, and even industrial assembly operations (Woodworth, 1938). This work suggested that the span varies with the size of the response unit, increasing as skill progresses from the letter stage, for example, to the word stage and beyond. Despite its long history, however, the determinants and functions of the receptor-effector span are still known only in a general way. According to Woodworth's discussion, it bears a direct relationship to the overlap of stages in action, to the size of the working unit, and to the skill of the worker. Thus it can be regarded as an index of the number of relevant cues being utilized for overt action and for covert preparation of action at the same time.

Woodworth's inferential analysis of the receptor-effector span has been largely confirmed in recent experiments at Cambridge. In a tracing task, Poulton (1950) measured the reaction times for changes in direction of trace after different warning periods. He found that if the warning time were sufficiently long, the trace could be altered smoothly and with no "block" or delay at the end of the first section of the trace. The "advance" information enabled the subjects to prepare the new response while completing the old. This conclusion was substantiated and extended by Leonard (1953). In other experiments, Poulton has shown the value of advance information in gaining precision in rapid action (1956), the disadvantage of an overload of advance information (1954), and the possible relationship between the optimum amount of advance information for a task and the size of the mnemonically convenient unit in that task (1958). Reviews of some of this work have been presented by both Bartlett (1950, 1951) and Poulton (1957). It is now possible to state that, in general, and up to a point determined by the nature of the task, the effect of increased foreknowledge is that responses can be made in larger units so that interresponse delay times become covert, interresponse junctions are smoothed, net speed increases, precision improves, and the performance may be generally described as better integrated.

While it is true that proficiency in some tasks is fairly closely and directly dependent on the extent of the receptor-effector span, this is not the case for all tasks. On some operations, only a small amount of advance information need be used for the preparation of adequate response, and additional foreknowledge or forecast is a handicap (Gottsdanker, 1956; Poulton, 1954). In such operations the number of task-relevant cues which can be usefully employed is likely to leave some of the subject's capacity unused. Such surplus capacity is accordingly available for response to irrelevant cues. Presumedly the task of continuous tracking in the experiment by Bahrick and co-workers, or in that by Bursill, was one of this type.

Tasks can be classified according to the complexity of the response they demand and the amount of advance information required for the preparation of this response. The least demanding tasks are those which require relatively little time and information for the adequate preparation of component responses. Long receptor-effector spans or large ranges of cue utilization yield no benefit and may even handicap performance. At the other extreme are tasks on which proficiency is recognized by the complexity of the response made. These most demanding tasks are nonrepetitive serial operations on which the most complex responses are the most highly rewarded. An example is the task of tracing complex mazes such as those in Porteus' series of tests (1956). Between these two extremes are many other tasks in which excellent performance demands varying amounts of time and information for the preparation of adequate responses. These tasks differ both in the length of the necessary receptor-effector span and in the degree to which this necessary span occupies the total capacity of the organism. The effect on proficiency of reductions in the range of cue utilization would depend on the complexity, according to this scale, of the operation studied.

CUE UTILIZATION AND EMOTIONAL DISINTEGRATION

The benefit of increased receptor-effector spans in serial tasks is to permit integration of component responses. Any degree of skill that depends on such integration will be reduced—will suffer disintegration—if the receptor-effector span is reduced. Reversing the gains of integration, then, the effect of reducing receptor-effector spans ought to be to increase the time required for the task, to allow the reappearance of interresponse delays (blocks), to destroy the smooth junction of elements of action, and in general to prevent attainment of the prescribed criteria of perfection such as proper emphasis in expressive oral reading.[2] Disintegration of this sort would be expected to ensue from the reduction in range of cue utilization by drive on those tasks in which the receptor-effector span approximated the total range, that is, on the most demanding tasks.

The task of encoding words in psychological experiments may be regarded as one of the most demanding tasks in the sense defined. Proficiency on it is directly related to the degree of integration achieved. The Combs and Taylor prediction can therefore be traced through in detail. Perception of threat raises drive level, reduces the range of cue utilization and the receptor-effector span, and so upsets the basis of integration. On Combs and Taylor's assumption that encoding offensive statements provokes threat reactions, their finding that such expressions were encoded less efficiently than neutral expressions further buttresses the generalization that the range of cue use is reduced in emotion. The authors emphasized the important point that the threat produced was a mild one.

[2] The span is described as a measure of range on the assumption that it represents a number of response-elements that coexist in different stages of development between intake of information and output of action, and which, in coexisting, facilitate their integration and the imposition of form or syntax onto response sequences. Lashley's masterful discussion of the problem of serial order in action (1951) suggests that imposed form or syntax itself reflects the use of additional cues. This assumption permits the treatment of form, order, and style as dependent upon a sufficient range of cue utilization.

The symptoms of disintegration on serial tasks have been reported to be more frequent in the performances of anxious subjects than control subjects in a number of other tasks that can be regarded as belonging to the "most demanding" category. These are: serial coding (Cohen, 1952; Katchmar, Ross, & Andrews, 1958; Lewinski, 1945; Payne, in press), paced problem solving (Easterbrook, 1953; Kelly, 1932), visible maze tracing (Foulds, 1951; Karpeles, 1932; Porteus, 1956), tracking with preview (Clarke, 1955; Himmelweit, 1947), mirror drawing (Beier, 1951; Wechsler & Hartogs, 1954; Wright, 1954), syntactic speech (Kelly, 1932; Luria, 1932), and, of course, the Luria association-motor task (Clarke, 1955; Luria, 1932). Since these effects could be produced by reduced receptor-effector spans, it may be that they too reflect the reduction in range of cue utilization that is expected with emotion. The reading difficulties of emotional children may indicate the operation of the same process, in reverse as it were, the higher drive preventing rather than destroying the gains of integration (Bond & Fendrick, 1936; Carmichael & Dearborn, 1948; Graham, 1952).

The memory span for digits is the receptor-effector span for the most demanding task that can be performed successfully in a series of increasing difficulty, when it is measured by the method familiar in intelligence testing. It is thus a measure of the range of cue utilization. If the disintegrated performance of emotional subjects on serial tasks were due to a reduced range of cue utilization as supposed, then that effect should be directly demonstrable with this measure. Indeed, low scores in tests of "immediate memory" span by anxious subjects have been reported when anxiety was determined by questionnaire (Lucas, 1952), induced by social (Lucas, 1952; Moldawsky & Moldawsky, 1952) or surgical threat (Wright, 1954), or chronic as neurosis (Clarke, 1955; Cohen, 1952; Lewinski, 1945). Such findings are sufficiently consistent to be regarded as pathonomic of anxiety (Hanfman, 1950; Payne, in press). The reduced digit span that has embarrassed psychologists by its persistently empirical validity as a sign of anxiety accordingly finds a rationale in the abstraction from learning and psychomotor experiments that the range of cue utilization is reduced in emotion. And its validity supports that generalization.

It is interested to note in passing that the modern measure of memory span was in fact devised to assess "span of prehension," which appears to have been the prebehavioristic equivalent of the range of cue utilization (Jacobs, 1887). Its inventor's expressed intention was to measure "the power of the mind to take on" as distinct from "taking in" information.

CUE UTILIZATION IN PERCEPTUAL TASKS

When embarking on consideration of perceptual skill in a response-oriented discussion such as this, it is well to be clear about the meaning given to the term "cue" in the expression "cue utilization." The writer believes it incorrect to speak of perception and response as if they were distinct processes when it is evident that perception is an active event and when the very concept of response implies preceding perception. The correct unit according to this view is the use of a cue. A singular cue can be said to have been used when a related response has occurred. In multicue situations, a particular cue can be said to have been used if the ensuing response takes a

form which it normally takes when that cue is present and normally does not take in its absence. However, a many-cued display can be treated as a single cue or a number of cues, depending on the distinctions a subject makes within it. The subject's behavior reflects the number of distinctions made; the more discriminative is the behavior, the greater is the number of cues that has been used. Except by introspection, neither discriminative perception nor discriminative response can be alleged to have occurred in the absence of evidence of both.

It has been suggested that the reduction under stress in the range of cue utilization represents a shrinkage of the perceptive field (Bursill, 1958; Callaway & Thompson, 1953; Combs & Taylor, 1952; Davis, 1948). If this designation is valid, it ought to be possible to demonstrate the effect with tasks commonly described as perceptual. In fact, Granger (1953) has mentioned nine clinical references to restriction of visual fields in anxiety. However, it would be expected that, in perceptual tasks as in other tasks, the effect of emotion on proficiency would depend on the number of cues needed for adequate performance of the task. The deleterious concomitants of increased drive would be expected to appear only when the actual range of cue utilization fell below that required for the task.

One means of constructing perceptual tasks that will require the use of a large number of cues is to reduce the definition of the cues normally available in relatively easy tasks, to disintegrate the cues, as it were. This might be done by reducing the physical differences between discriminanda, lowering illumination, reducing exposure time, physically cutting out some stimuli with "reduction screens," and so on. In such conditions, relative impairment in discrimination has been reported to arise from pre-parachuting anxiety (Basowitz, Persky, Korchin, & Grinker, 1955) and from threat-induced and manifest anxiety (Moffitt & Stagner, 1956). The persistent reports of impaired night vision among neurotics (Eysenck, 1948; Eysenck, Granger, & Brenglemann, 1957; Granger, 1957; Slater & Slater, 1944) may also signify a reduction in cue utilization due to high drive. The somewhat equivocal demonstrations of increased stimulus generalization in emotion (Eriksen, 1954; Kamin, Bindra, Clark, & Waksberg, 1955; Rosenbaum: 1953, 1954; Spence & Farber, 1954) seem to depend upon displays that provide indefinite cues and, of course, to reflect the principle under discussion. Broadhurst (1957; in press) has reviewed some of the evidence for the Yerkes-Dodson law that the optimum intensity of (drive) stimulus falls with increase in difficulty of discrimination—a conclusion originally stated in more general terms after an experiment on the behavior of mice escaping from shock through doors that differed from blinds in visual brightness (Yerkes & Dodson, 1908). In all of these cases the use of cues was impaired by increase in drive.

Eysenck, Granger, and Brenglemann (1957) have reported a series of experiments on perceptual processes and mental illness, which culminated in a factor analysis. One of the factors they extracted showed considerable power for differentiating between normal, neurotic, and psychotic groups as clinically defined. Three of the four defining tests for this factor were measures of speed and accuracy of recognition with impoverished displays. They were: (*a*) speed of recognition of content and depth in tachistoscopically exposed displays of a model human bust and a pair of

spectacles, (*b*) Snellen visual acuity (confirming a report by the Slaters, 1944), and (*c*) a tachistoscopic letter recognition test. Neurotic and psychotic patients were slower in three-dimensional perception, made lower acuity scores and lower scores for recognizing briefly exposed letters, again showing reduced use of the cues presented.

Relative increases in recognition duration thresholds with emotion have also been reported from experiments using pictures and clinical abnormality (Davis & Cullen, 1958), neutral and taboo words (Postman & Bruner, 1948), visual form and test anxiety (Rockett, 1956), words and previously associated electro-shock (Eriksen & Browne, 1956; Rosen, 1954), and words and previously associated auditory annoyance (Hochberg & Brooks, 1958). In these and other cases of so-called "perceptual defense," it is presumed that the emotional reaction occurred before recognition was completed and interfered with the subsequent course of the perceptual process, an assumption for which Davies and Cullen (1958) have provided some evidence.

Eysenck, Granger, and Brenglemann drew particular attention to the fact that the duration threshold for perception of the third dimension was among their most discriminative measures. It is perhaps not coincidental, therefore, that it was for the purpose of explaining results attributed to loss of distance cues that Callaway and Thompson (1953) derived their "narrowed attention" form of the generalization under discussion. When their subjects were required to hold one foot in a bucket of ice water, they overestimated the size of standard stimuli, by setting as equal to them distant stimuli larger than those selected under control conditions. The investigators substantiated their belief that minimal cues to distance estimation had been lost by demonstrating a breakdown in ability to estimate distance under similar conditions.

Results partially comparable to those of Callaway and Thompson were found by Singer (1952), with the relative distances of variable and standard stimuli reversed. Singer's standard stimuli were overestimated under three conditions: when meaningful as compared with meaningless symbols were drawn upon them, when the subjects were motivated to greater accuracy by being instructed to select the variable stimulus so that they could bet its size was equal to that of the standard rather than selecting one which merely looked the same, and when the subjects had been frustrated by fifteen minutes work on an insoluable concept-formation task with the experimenter feigning alarm and despondency at their performance. Again, Sanders and Pacht (1952) found that their neurotic and psychotic subjects made larger estimates of the sizes of standard stimuli than their normal subjects. Results of the kind Callaway and Thompson set out to explain are not limited to their own experiment, though their finding that more distant cues tend to appear smaller under stress was not borne out by Singer's work. It seems to be more generally true that the target stimulus, the one to be matched, becomes phenomenally larger in some circumstances.

Klein (1957) found that errors in estimation of the sizes of experimental stimuli were increased in groups of thirsty as compared with control subjects. This result was independent of whether the stimuli bore need-related or need-neutral symbols. However, in contrast to the results mentioned above,

Klein found that some of the greater errors of his high drive subjects were underestimates.

Klein's results make it clear that if there is a common phenomenon associated with increased drive in the size-matching experiments cited, then that phenomenon is simply a change from normal in the apparent relative size of the stimuli being compared. This is, in fact, the sort of phenomenon which the Callaway and Thompson notion of narrowed attention under stress is prepared to explain. The emotional restriction of the attentive field would be supposed to operate in somewhat the way that a reduction screen operates in upsetting constancy effects (although it would not necessarily produce the identical charges in perception, because the percept would depend on the cues still employed).

According to Jenkins (1957), who has written a comprehensive review on the matter, the evidence supports the belief that the size of valued objects is accentuated in perception, particularly when there is some degree of ambiguity or equivocality in the display. Conceivably, a necessary condition for the appearance of this phenomenon is a narrowing of attention, the emotional component being contributed in the evaluative response of the subject. Of course, a second factor would be needed to explain why a reduction in the use of some cues sometimes results in accentuation of the valued object. It will be remembered that Singer (1952) found that stimuli bearing meaningful symbols were accentuated in perception and that this effect was exaggerated by motivating instructions or frustration. Thus the meaningful character of the valued object as a stimulus may contribute to the enhancement process. Perhaps it serves to arrest the narrowed attention, rendering the attended cue central and reducing the comparison stimuli to the role of "ground." In this connection, reference must be made to the report by Dukes and Bevan (1952) on the judgment by children of the weight of jars containing candy and jars containing sand and sawdust. These writers found accentuation effects and reported that the accentuation effects were coupled with decreased variability of response.

A final type of change in perceptual performance with increased drive is the greater recognition speed that is sometimes described as perceptual sensitization. An instance of this kind of effect is given by Engler and Freeman (1956), who studied the effects on visual recognition duration thresholds of instructional set and questionnaire-assessed anxiety. In the absence of special instructions about the types of word stimuli to expect, the high "drive" subjects achieved lower duration thresholds than did the low "drive" subjects. When this information was provided, it lowered the thresholds of the low drive subjects only. Drive apparently operated in lieu of set, facilitating the recognition response. The functional equivalence of drive and set in this experiment supports the interpretation that drive increment here produced effects analogous to the concentration or focusing phenomena described earlier.

The literature on the effects of drive on perceptual proficiency is wide and apparently contradictory. As the examples cited have indicated, drive increment sometimes facilitates and sometimes impairs performance. Both reduced and increased recognition duration thresholds have been reported. Some cues are enchanced in extent or intensity (Gilchrist & Nesberg, 1952), while others appear to diminish in phenomenal value. Now these results are similar to the effects of emotion on proficiency in perceptual-motor

tasks which were described above. Whether the effect of emotion in those cases was to be classified as facilitative or disruptive depended solely upon what was taken to be the task. Tasks requiring the use of greater numbers of cues were disrupted, while tasks requiring the use of smaller numbers of cues were facilitated by drive increment. However, there was no difficulty in describing the effects of drive increment in unconditional terminology as reductions in the range of cue utilization. It has been indicated that the diverse results in perception can be reconciled in the same manner. Both facilitative and disruptive effects can be regarded as resulting from reductions in the range of cue utilization.

In the discussion of accentuation of perceived size, it was suggested that whether the size of an object would be underestimated or overestimated when drive was increased might depend on characteristics determining whether it would be central or peripheral in perception. This proposition is a counterpart of the conclusion that whether the effect of emotion should be described as facilitative or disruptive depended upon whether the central or the central plus peripheral task was considered. There is a similarity between the way in which central tasks occupy an increasing proportion of the subject's resources and the way in which figures are accentuated under high drive. Both events are contingent on the recession of marginal cues. And in both cases description of the event ceases to be conditional if it refers to this change in the number of cues employed.

FACILITATION AND DISRUPTION

Previous writers have contended that the criterion for distinguishing between motivational and emotional events is proficiency of action. To the extent that an orectic event serves to organize a course of action, it has been agreed to be "motivational" (Leeper, 1948; Smith, 1958). When it leads to disruption of a course of action, opinions differ as to whether it should be called "emotional" (Smith, 1958) or not (Leeper, 1948). Leeper assumed that disruption only occurs when two different organizing processes have come into conflict, so that it too is an organizing event. This is not true. Mere increase in general excitement can disrupt complex action sequences. At the same time, disruptive effects do seem to be restricted to the use of cues that are effectively or perceptively peripheral in some way. Thus, increased drive tends to interfere with the use of incidental cues, perhaps diminishing their phenomenal value and delaying reaction to them. Meanwhile, however, it also tends to sharpen or concentrate action, and perhaps to enhance the phenomenal importance of central cues and to expedite reaction to them. The facts and their classification can be reconciled by avoiding use of terms like "organizing" and "disorganizing," and speaking of the nature of the central cues and the range of cue utilization instead.

Accordingly, it is proposed that whether a course of action is facilitated or disrupted by emotion depends on its complexity and upon the range of cue utilization left to the actor in his emotion.

Task complexity has been defined in terms of the number of cues that must be utilized simultaneously to achieve the type of behavior required by that task. Plainly those operations that were facilitated when the use of irrelevant cues was reduced—for instance, the tracking operation by the subjects of Bahrick et al., or that of

finding food in the initial runs by the rats of Bruner and co-workers—might have been impaired if the reduction had proceeded further so that relevant cues were also excluded. Continued reduction in the range of cue use would thus first improve and then impair proficiency. It would in fact produce just the sort of up and down relation between proficiency and drive that is familiar in connection with the names of Yerkes and Dodson (1908; and, e.g., Broadhurst, 1957; Courts, 1942; Shaw, 1956; Shore, 1958; Stennett, 1957). Moreover, on the hypothesis that the range of cue utilization is reduced when drive rises, this analysis provides an explanation of this familiar effect.

Regard the curvilinear relation between drive and proficiency as the resultant of two functions: one in which proficiency is a function of the number of cues in use, and one in which the number of cues in use is negatively dependent upon drive level. Assume now (*a*) that simultaneous use of task-relevant and task-irrelevant cues reduces the effectiveness of response to some extent, and (*b*) that as the total number of cues in use is reduced, task-irrelevant cues are excluded before task-relevant cues. For any task, then, provided that initially a certain proportion of the cues in use are irrelevant cues (that the task demands something less than the total capacity of the organism), the reduction in range will reduce the proportion of irrelevant cues employed and so improve performance. When all irrelevant cues have been excluded, however (so that now the task demands the total capacity of the subject), further reduction in the number of cues employed can only affect relevant cues, and proficiency will fall. If drive increments produce these changes in range of cue use, they will also produce this succession of facilitation and impairment.[3]

The effect of learning on the relation between drive and proficiency on this hypothesis would be complex. Some speculative proposals may be offered, however. In the first place, learning might be expected to reduce the number of irrelevant cues in use (e.g., on a statistical theory [Estes, 1955]). Thus it would tend to produce the effects here ascribed to increased drive. Bruner, Matter, and Papanek (1955) have in fact reported that overlearning and high drive were alike in reducing the range of cue utilization in their experiments on breadth of learning by rats. A second effect of learning might be to increase the number of relevant cues in use, and consequently to raise proficiency further. The point of optimum proficiency on the continuum of cue utilization would then move toward the higher number of cues. That is to say, the optimum drive level would be reduced by such an effect.

[3] A shorthand expression of this hypothetical relation between drive and proficiency can be constructed. In the expression $P = 1/Q(C - f(R - C)$, the symbol P represents proficiency, with a maximum of 1 and a minimum of zero for each task, Q represents the number of cues that must be used simultaneously for adequate performance of the task, R represents the total number of cues that are in fact used (the range), C is the number of task-relevant cues in use (i.e., $C \leqslant Q$, $C \leqslant R$), and $f(R - C)$ represents the interference arising from concurrent use of irrelevant cues. If C be assumed to increase with training, then the proficiency curve rises with training, and so does the range of cue use that is necessary to produce optimal proficiency. For any task, proficiency reaches a maximum when $C = Q = R$. To translate the equation to give a regression of P on drive, it is necessary merely to write an expression of the generalization that drive reduces range (e.g., $R = kS/D$, in which k is a constant less than D, and S is the maximum R), and then to substitute for R in the expression of P.

This, in fact, was the result Courts (1942) found with practice in the relation between neuromuscular tension and proficiency in memorization. The third major effect of learning that might be expected is the one discussed by Miller (1956) as "coding." Groups of cues may come to form larger perceptual units, attached to larger response units, so that the number of cues required for proficient performance might fall. This would tend to produce a relation between practice and optimum drive level opposite to that found by Courts. In tasks in which larger perceptual units emerge after practice, the optimum drive ought to undulate about a downward trend with practice.

CUE UTILIZATION AND INFORMATION TRANSFER

The range of cue utilization has been treated as if it were equivalent to the amount of information in use at any one time. In fact, under certain circumstances there is a formal relation between the range of cue utilization and the measure of total information transfer. The information transferred in bits is the number of cues in use, raised by a function of the probability of occurrence of any one of those cues. The similarity of the two conceptual systems is even greater if information is measured in "chunks," which is Miller's expression for the information unit when perceptual integration of physical stimuli has occurred and the integral units have been coded to new symbols or phenomenal stimuli. Miller's important discussion (1956) must be read in the original.

It is necessary to be clear about the sense in which cue utilization is related to information transfer. A stimulus is said to convey information when it serves to elict the associated one of a number of responses from a set or repertoire of responses. The amount of information transferred when a given response has been elicited varies logarithmically with the number of alternative responses in the set from which it was selected. Thus, situations differ in the size of the set of potential responses corresponding to the number of different stimuli present with which discrete responses are associated. The overt occurrence of any one of these responses as a consequence of the appropriate stimulus reflects both the use of that cue and the transfer of information.

The information transferred in any given S-R event is a log (to the base 2) function of the number of possible responses in a situation. In the same way, the information conveyed by any given series of cues is a log function of the number of different sequences of cues that could arise. Appropriate response sequences such as those involved in oral reading and the other serial tasks discussed above therefore reflect the transfer of information in the same sense as do appropriate single responses.

The two systems of description are compatible also with regard to the relevance-irrelevance dimension. Insofar as any cue elicits an associated response, it can be said to have been used, or to have transferred information. It is therefore correct to speak of the transfer of relevant or irrelevant information, in the same way that it is correct to speak of the use of relevant or irrelevant cues. Relevance is *not* intrinsic to information in this definition. Relevance has to do with the relation between information and task requirements.

Translated into information terminology, the generalization under discussion asserts that the total amount of information transferred through the actions of an animal falls with increase in drive level. It is possible, but more

hypothetical, that this is equivalent to saying that channel capacity is reduced in emotion, or that the rate of gain of information (Hick, 1952) falls off.

The shift in terminology from "range of cue utilization" to "total information transfer" is intended merely to replace old words with new. The difficulty of conducting a discussion in the old terms has been demonstrated by what has been written so far. The hypothetical identity of the events which have been discussed is somehow obscured by the diversity of terms. If "shrinkage of perceptual field," "increase in stimulus generalization," and "rise in duration threshold" can be described in common terms, as measures of reduction in total information transfer, their essential similarity may be more readily recognized and treated.[4]

An application of information terminology that may be particularly fruitful is to the important matter of describing task difficulty. At present the language is limited to those cases in which the stimulus-response connections are already available and the subject's uncertainty consists in selecting from among habitual and instinctive responses those which the display demands. Despite this limitation, this language clearly covers the sense for which the term "response complexity" has been used above. The most difficult tasks and those for which most complex responses are required are tasks which demand long and a priori improbable sequences of responses, and accordingly reflect the transfer of great amounts of information. The applicability of information language to the description of task difficulty has been demonstrated by Miller (1956) in reference to absolute judgment and immediate memory and by others in reference to multiple-choice reaction time (Hick, 1952; Poulton, 1956), visual recognition (e.g., Fitts, Weinstein, Rappaport, Anderson, & Leonard, 1956; Newbrough, 1958), jig saw puzzle working (Solley & Snyder, 1958), absolute judgment (Garner, 1953), and immediate memory (Aborn & Rubenstein, 1952; Pollack, 1953). This list contains several cases that are comparable with studies cited above on the effect of drive, and such comparisons show that a deficiency of information and an excess of anxiety are functionally equivalent.

[4] Hick, in a pioneer information theory study of the relation between multiple choice reaction time and the number of choices required (1952), considered why his reaction times should fit a straight line regression on the logarithm of the number of alternatives. To account for this confirmed effect, he suggested that perhaps the subject actually sorts through the alternatives serially. That is to say, he suggested that the multiple-choice reaction task was a serial task. It is known that visual recognition reaction times bear a similar relation to stimulus complexity. If Hick's suggestion were correct and applied to these data, then it is possible that the task of identifying which letter of the alphabet is displayed on a chart is a serial task. Lashley (1951) has offered some related speculations. The similarity between serial psychomotor tasks and simple perceptual tasks may be a good deal closer than the foregoing empirical classification implies.

WIDER IMPLICATIONS

As mentioned in the introduction, Bruner, Matter, and Papanek (1955) have shown how the concept of "range of cue utilization" can account for the different degrees of continuity in learning and for the different amounts of latent learning that have been observed by various workers. The argument here has provided a rationale for expecting both facilitation and impairment of performance on any given task as the range of cue utilization is reduced from a level above to one below that required for the task. Evidence has been cited or reviewed in support of the general proposition that when drive level rises there is a concomitant

decrease in the range of cue utilization. This generalization and the argument can account for both the organizing and the disorganizing effects of emotion.

It has been argued that the range of cue utilization may be alternately described as "total information transfer." This designation implies that the range is an index of cerebral competence (Cameron, 1947) in some sense. Two recent major reviews of comparative psychology have included hypotheses to this effect. Hebb and Thompson (1954) make the proposition ". . . that the intellectual development in phylogenesis that eventually makes speech possible is an increasing independence of the conceptual activity from the present sensory environment and an increasing capacity for entertaining diverse conceptual processes at the same time" (p. 539). Nissen (1951) writes: "With ascent in the phyletic scale, the effective environment expands spatially and temporally and provides an ever-wider range of behavior determinants" (p. 381). As further support for this hypothesis, it is notable that the range of cue utilization appears to be reduced by aging (e.g., Birren, 1952; Griew, 1958; Kirchmer, 1958; Welford, 1951). Moreover, recent work on the integration of simultaneous stimuli by brain-damaged subjects (e.g., Beech, 1956; Bender, 1945; Bender, Fink, & Green, 1951; Teuber & Mishkin, 1954) suggests that it is reduced in this condition too. Inability to utilize all available cues seems to explain the faults in spatial orientation these subjects display in certain circumstances. Beech (1956) has noted that the tendency of brain-damaged individuals to make errors of orientation in drawn reproductions of figures is negatively related to intelligence. This correlation strikes to the heart of the question and supports the proposition that the range of cue utilization is an index of cerebral competence—as, indeed, Jacobs (1887) assumed for his "prehension span" when he tried it on idiots years ago, and as Porteus (1956) too has been saying for years about his maze scale.

If it is true that the range of cue utilization is an index of cerebral competence, and that emotion tends to reduce this range, then Cameron (1947) has been right in his traditional assumption that emotion reduces cerebral competence.

Several coincidences with general psychological principles bear on the explanation of the reduction in range of cue utilization in emotion. First, what may be called "the behavioral law" asserts that the probability of occurrence of a dominant response is raised by increase in drive (Hull, 1943). The obverse of this principle is that the probability of reaction to the cues for other responses is simultaneously reduced. Maltzman, Fox, and Morrisett (1953) have applied this version of the behavioral law to the explanation of the role of emotion in the development of rigid behavior in Luchins-type problem solving situations (Beier, 1951; Cowen: 1952a, 1952b; Pally, 1954), an association also noted elsewhere (e.g., Davis & Cullen, 1958; Maier, 1956; Roseman, 1952). The inverted behavioral law may be identical with the abstraction that the range of cue use is reduced in emotion, although the importance of the habit element has not been demonstrated in all cases to which the concept has been applied.

The abstraction under discussion spans a very wide area. It embraces the behavioral law—inversely, as it were. In a similar way it also incorporates the related Hullian (1943) proposition that drive increment increases "stimulus generalization," which

is the tendency of stimuli other than the training stimulus to evoke a trained response. This proposition implies that the segment of a stimulus continuum that consitutes a cue for a trained response becomes broader and broader as drive level rises. Thus fewer distinctions are made within the continuum, and fewer different cue-uses are possible. By like argument, the Yerkes-Dodson law, too, can be included in the generalization under discussion, as shown above. According to this principle, as drive level rises, some cues lose their effectiveness for guiding action (Broadhurst: 1957; in press; Yerkes & Dodson, 1908). Finally, if intense external stimulation is like the "noxious" external stimulation or the internal stimulation of drive, then a third psychophysical law can be put with these two. This is the proposition that a given difference of intensity between two stimuli becomes less discriminable at high levels on the stimulus scale (Stevens, 1957), which again implies a reduction in the number of cue-uses available. Thus the generalization that increase in emotion lowers the range of cue utilization can incorporate theory as well as fact both from studies of perception and studies of other behavior.

In addition to its comprehensive character, the principle under discussion is more complete than those it embraces in another sense. It tells about what is happening when the organism under low drive makes relatively few effective responses to a simple central task compared to the number made by an organism under high drive. Without examining this aspect of response to emotion, it is not possible to be clear about how emotion affects behavior. For if the effect of drive be inferred from its effect on a central task only, then it is quite justifiable to suspect that with drive low the organism is responding to few cues of any kind, fails to remember responses, or is incapable of integrated action. Such inferences might lead readily to the view that a certain amount of emotion tends to make an organism more vigilant and capable than an undisturbed animal would be.

Finally, it is important to note that there is no conflict between the data on simultaneity of cue utilization and the behavioristic assumption that cues are dealt with one at a time. This is because responses overlap after being started in succession. Even though there must be many channels in which a number of responses can be said to be occurring at once, there is still a single-cue channel somewhere that affects events elsewhere in the system (Broadbent, 1957a; Carmichael & Dearborn, 1948; Hick, 1952; Mowbray, 1954). Broadbent (1957b) has outlined a mechanical model for attention and immediate memory which reconciles these two requirements. Single response theories of behavior, extended to sequences of responses where necessary, are therefore capable of rationalizing the empirical generalization that the range of cue utilization is reduced in emotion.

SUMMARY

The effect of emotion on behavior has been discussed in reference to the empirically derived generalization that the number of cues utilized in any situation tends to become smaller with increase in emotion.

On some tasks reduction in the range of cue utilization improves performance. Irrelevant cues are excluded and drive is then said to be organizing or motivating. In other tasks, proficiency demands the use of a wide range of cues, and drive is disorganizing or emotional. There seems

to be an optimal range of cue utilization for each task.

The argument suggests that motivational concentration of action in a given direction is merely an early stage in an emotional process that acts consistently to reduce the range of cue utilization. This view rationalizes some experimental measures of anxiety and provides a parsimonious interpretation of a number of facts about attentive behavior.

The generalization and the argument can be translated into information terminology, which promises particular utility for describing task difficulty.

The range of cue utilization can be regarded as an index of cerebral competence, and the generalization then asserts that cerebral competence is reduced in emotion.

The abstraction relating the range of cue utilization to emotion is capable of subsuming several other principles as special cases. No explanation of the relationship is proposed, but it is implied that no major revision of current theory is required to produce one.

REFERENCES

ABORN, M. The influence of experimentally induced failure on the retention of material acquired through set and incidental learning. *J. exp. Psychol.*, 1953, **45**, 225–231.

ABORN, M., & RUBENSTEIN, H. Information theory and immediate recall. *J. exp. Psychol.*, 1952, **44**, 260–266.

BAHRICK, H. P. Incidental learning under two incentive conditions. *J. exp. Psychol.*, 1954, **47**, 170–172.

BAHRICK, H. P., FITTS, P. M., & RANKIN, R. E. Effect of incentives upon reactions to peripheral stimuli. *J. exp. Psychol.*, 1952, **44**, 400–406.

BARTLETT, F. Program for experiments on thinking. *Quart. J. exp. Psychol.*, 1950, **2**, 145–152.

BARTLETT, F. Anticipation in human performance. *Essays in psychology dedicated to David Katz.* Upsala: Almquist and Wicksells, 1951.

BASOWITZ, H., PERSKY, H., KORCHIN, S. J., & GRINKER, R. R. *Anxiety and stress.* New York: McGraw-Hill, 1955.

BEECH, H. R. An investigation of the performance on a perceptual-motor task by psychiatric patients with special reference to brain damage. Unpublished Ph.D. thesis, Univer. of London Library, 1956.

BEIER, E. G. The effect of induced anxiety on flexibility of intellectual functioning. *Psychol. Monogr.*, 1951, **65**, No. 9 (Whole No. 326).

BENDER, M. B. Extinction and precipitation of cutaneous sensations. *Arch. Neurol. Psychiat.*, 1945, **54**, 1–9.

BENDER, M. B., FINK, M., & GREEN, M. Patterns in perception on simultaneous tests of face and hand. *Arch. Neurol. Psychiat.*, 1951, **66**, 355–362.

BINDRA, D. Organization in emotional and motivated behaviour. *Canad. J. Psychol.*, 1955, **9**, 161–167.

BIRREN, J. E. A factorial analysis of the Wechsler-Bellevue scale given to an elderly population. *J. consult. Psychol.*, 1952, **16**, 399–405.

BOND, G., & FENDRICK, P. Delinquency and reading. *J. genet. Psychol.*, 1936, **48**, 236–243.

BROADBENT, D. E. Immediate memory and simultaneous stimuli. *Quart. J. exp. Psychol.*, 1957, **9**, 1–11. (a)

BROADBENT, D. E. A mechanical model for human attention and immediate memory. *Psychol. Rev.*, 1957, **64**, 205–215. (b)

BROADHURST, P. L. Emotionality and the Yerkes-Dodson law. *J. exp. Psychol.*, 1957, **54**, 345–352.

BROADHURST, P. L. The interaction of task difficulty and motivation: The Yerkes-Dodson law revived. *Acta psychol.*, in press.

BRUNER, J. S., MATTER, JEAN, & PAPANEK, MIRIAM L. Breadth of learning as a function of drive level and mechanization. *Psychol. Rev.*, 1955, **62**, 1–10.

BURSILL, A. E. The restriction of peripheral vision during exposure to hot and humid conditions. *Quart. J. exp. Psychol.*, 1958, **10**, 113–129.

CALLAWAY, E., & DEMBO, E. Narrowed attention: A psychological phenomenon that accompanies a certain physiological change. *Arch. Neurol. Psychiat.*, 1958, **79**, 74–90.

CALLAWAY, E., & THOMPSON, S. V. Sympathetic activity and perception. *Psychosom. Med.*, 1953, **15**, 443–455.

CAMERON, N. *The psychology of behavior disorders.* New York: McGraw-Hill, 1947.

CARMICHAEL, L., & DEARBORN, W. F. *Reading and visual fatigue.* London: Harrap, 1948.

CLARKE, A. D. B. The measurement of emotional instability by means of objective tests—An experimental enquiry. Unpublished Ph.D. thesis, Univer. of London Library, 1950. Partially reported in *Brit. J. Psychol.,* 1955, **46**, 38–43.

COHEN, J. Factors underlying Wechsler-Bellevue performance of three neuropsychiatric groups. *J. abnorm. soc. Psychol.,* 1952, **47**, 359–365.

COMBS, A. W., & TAYLOR, C. The effect of the perception of mild degrees of threat on performance. *J. abnorm. soc. Psychol.,* 1952, **47**, 420–424.

COURTS, F. A. The influence of practice on the dynamogenic effect of muscular tension. *J. exp. Psychol.,* 1942, **30**, 504–511.

COWEN, E. L. The influence of varying degrees of psychological stress on problem-solving rigidity. *J. abnorm. soc. Psychol.,* 1952, **47**, 512–519. (a)

COWEN, E. L. Stress reduction and problem-solving rigidity. *J. consult. Psychol.,* 1952, **16**, 425–428. (b)

DAVIS, D. R. *Pilot error.* Air Publication 3139A. London: H. M. Stationery Office, 1948.

DAVIS, D. R., & CULLEN, J. H. Disorganization of perception in neurosis and psychosis. *Amer. J. Psychol.,* 1958, **71**, 229–237.

DUFFY, E. Leeper's "Motivational theory of emotion." *Psychol. Rev.,* 1948, **55**, 324–328.

DUKES, W., & BEVAN, W. Accentuation and response variability in the perception of personally relevant objects. *J. Pers.,* 1952, **20**, 457–465.

EASTERBROOK, J. A. The measurement of perseverance. Unpublished M. A. thesis, Queen's Univer. Library, Kingston, Ont., 1953.

ENGLER, J., & FREEMAN, J. T. Perceptual behavior as related to factors of associative and drive strength. *J. exp. Psychol.,* 1956, **51**, 399–404.

ERIKSEN, C. W. Some personality correlates of stimulus generalization under stress. *J. abnorm. soc. Psychol.,* 1954, **49**, 561–565.

ERIKSEN, C. W., & BROWNE, C. T. An experimental and theoretical analysis of perceptual defense. *J. abnorm. soc. Psychol.,* 1956, **52**, 224–230.

ESTES, W. K. Statistical theory of spontaneous recovery and regression. *Psychol. Rev.,* 1955, **62**, 224–230.

EYSENCK, H. J. *Dimensions of personality.* London: Kegan-Paul, 1948.

EYSENCK, H. J., GRANGER, G. W., & BRENGLEMANN, J. C. *Perceptual processes and mental illness.* London: Chapman and Hall, 1957.

FITTS, P. M., WEINSTEIN, M., RAPPAPORT, M., ANDERSON, NANCY, & LEONARD, J. A. Stimulus correlates of visual pattern recognition: A probability approach. *J. exp. Psychol.,* 1956, **51**, 1–11.

FOULDS, G. A. Temperamental differences in maze performance, Part 1: Characteristic differences among psychoneurotics. *Brit. J. Psychol.,* 1951, **42**, 209–217.

GARNER, W. R. An informational analysis of absolute judgments of loudness. *J. exp. Psychol.,* 1953, **46**, 373–380.

GILCHRIST, K., & NESBERG, L. S. Need and perceptual change in need-related objects. *J. exp. Psychol.,* 1952, **44**, 369–376.

GOTTSDANKER, R. M. Prediction span, speed of response, smoothness and accuracy in tracking. *Percept. mot. Skills,* 1956, **6**, 171–181.

GRAHAM, E. E. Wechsler-Bellevue and WISC scattergrams of unsuccessful readers. *J. consult. Psychol.,* 1952, **16**, 268–271.

GRANGER, G. W. Personality and visual perception: A revision. *J. ment. Sci.,* 1953, **99**, 8–43.

GRANGER, G. W. Night vision and psychiatric disorders. *J. ment. Sci.,* 1957, **103**, 48–79.

GRIEW, S. Age changes and information loss in performance of a pursuit tracking task involving interrupted preview. *J. exp. Psychol.,* 1958, **55**, 486–489.

HANFMANN, EUGENIA. Psychological approaches to the study of anxiety. In P. M. Hoch & J. Zubin (Eds.), *Anxiety.* New York: Greene & Stratton, 1950. Pp. 51–69.

HEATH, D. H. Individual anxiety thresholds and their effect on intellectual performance. *J. abnorm. soc. Psychol.,* 1956, **52**, 403–408.

HEBB, D. O., & THOMPSON, W. R. The social significance of animal studies. In G. Lindzey (Ed.), *Handbook of social psychology.* Cambridge, Mass.: Addison-Welsley, 1954. Pp. 532–561.

HICK, W. E. On the rate of gain of information. *Quart. J. exp. Psychol.,* 1952, **4**, 11–26.

HIMMELWEIT, HILDE T. A comparative study of level of aspiration of normal and of neurotic persons. *Brit. J. Psychol.*, 1947, **37**, 41–59.

HOCHBERG, J., & BROOKS, V. Effects of previously associated annoying stimuli (auditory) on visual recognition thresholds. *J. exp. Psychol.*, 1958, **55**, 490–491.

HULL, C. L. *Principles of behavior.* New York: Appleton Century, 1943.

JACOBS, J. Experiments on "prehension." *Mind*, 1887, **12**, 75–79.

JENKINS, N. Affective processes in perception. *Psychol. Bull.*, 1957, **54**, 100–127.

JOHNSON, E. E. The role of motivational strength in latent learning. *J. comp. physiol. Psychol.*, 1952, **45**, 526–530.

KAMIN, L. J., BINDRA, D., CLARK, J. W., & WAKSBERG, HELENE. The interrelation among some behavioural measures of anxiety. *Canad. J. Psychol.*, 1955, **9**, 79–83.

KATCHMAR, L. T., ROSS, S., & ANDREWS, T. G. Effects of stress and anxiety on performance of a complex verbal coding task. *J. exp. Psychol.*, 1958, **53**, 559–564.

KARPELES, LOTTA M. A further investigation of the Porteus maze test as a discriminative measure in delinquency. *J. appl. Psychol.*, 1932, **16**, 427–437.

KELLY, G. Some common factors in reading and speech disabilities. In C. A. Ruckmick (Ed.), University of Iowa studies in psychology. *Psychol. Monogr.*, 1932, **43**, No. 1 (Whole No. 194). Pp. 175–201.

KIRCHMER, W. K. Age differences in short-term retention of rapidly changing information. *J. exp. Psychol.*, 1958, **55**, 352–358.

KLEIN, G. S. Need and regulation. In M. R. Jones (Ed.), *Nebraska symposium on motivation.* Lincoln: Univer. Nebraska Press, 1957. Pp. 224–274.

KOHN, H. Effects of variations of intensity of experimentally induced stress situations upon certain aspects of perception and performance. *J. genet. Psychol.*, 1954, **85**, 289–304.

LASHLEY, K. S. The problem of serial order in behavior. In L. A. Jeffress (Ed.), *Cerebral mechanisms in behavior.* New York: Wiley, 1951. Pp. 112–146.

LEEPER, R. W. A motivational theory of emotion to replace "emotion as disorganized response." *Psychol. Rev.*, 1948, **55**, 5–21.

LEONARD, J. A. Advance information in sensori-motor skills. *Quart. J. exp. Psychol.*, 1953, **5**, 141–150.

LEWINSKI, R. J. The psychometric pattern: 1. Anxiety neurosis. *J. clin. Psychol.*, 1945, **1**, 214–221.

LUCAS, J. D. The interactive effects of anxiety, failure and intra-serial duplication. *Amer. J. Psychol.*, 1952, **65**, 59–66.

LURIA, A. R. *The nature of human conflict.* (Trans. by W. Horsley Gantt) New York: Liveright, 1932.

MAIER, N. R. F. Frustration theory: Restatement and extension. *Psychol. Rev.*, 1956, **63**, 370–388.

MALTZMAN, I., FOX, J., & MORRISETT, L., JR. Some effects of manifest anxiety on mental set. *J. exp. Psychol.*, 1953, **46**, 50–54.

MILLER, G. A. The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychol. Rev.*, 1956, **63**, 81–97.

MILLER, N. E. Experimental studies of conflict. In J. McV. Hunt (Ed.), *Personality and the behavior disorders.* New York: Ronald, 1944. Pp. 431–465.

MOFFITT, J. W., & STAGNER, R. Perceptual rigidity and closure as functions of anxiety. *J. abnorm. soc. Psychol.*, 1956, **52**, 354–357.

MOLDAWSKY, S., & MOLDAWSKY, PATRICIA C. Digit span as an anxiety indicator. *J. consult. Psychol.*, 1952, **16**, 115–118.

MOWBRAY, G. H. The perception of short phrases presented simultaneously for visual and auditory perception. *Quart. J. exp. Psychol.*, 1954, **6**, 86–92.

NEWBROUGH, J. R. Interaction between total stimulus information and specific stimulus information on visual recognition. *J. exp. Psychol.*, 1958, **55**, 297–300.

NISSEN, H. W. Phylogenetic comparison. In S. S. Stevens (Ed.), *Handbook of experimental psychology.* New York: Wiley, 1951. Pp. 347–386.

PALLY, S. Cognitive rigidity as a function of threat. *J. Pers.*, 1954, **23**, 346–355.

PAYNE, R. W. Cognitive abnormalities. In H. J. Eysenck (Ed.), *Handbook of abnormal psychology.* London: Pitman, in press.

POLLACK, I. Assimilation of sequentially encoded information. *Amer. J. Psychol.*, 1953, **66**, 421–435.

PORTEUS, S. D. Porteus maze developments. *Percept. mot. Skills*, 1956, **6**, 135–142.

POSTMAN, L., & BRUNER, J. S. Perception under stress. *Psychol. Rev.*, 1948, **53**, 314–324.

POULTON, E. C. Perceptual anticipation and reaction time. *Quart. J. exp. Psychol.*, 1950, **2**, 99–112.

POULTON, E. C. Eye-hand span in simple serial tasks. *J. exp. Psychol.*, 1954, **47**, 403–410.

POULTON, E. C. The precision of choice reactions. *J. exp. Psychol.*, 1956, **51**, 98–102.

POULTON, E. C. On prediction in skilled movements. *Psychol. Bull.*, 1957, **54**, 467–478.

POULTON, E. C. Copying behind during dictation. *Quart. J. exp. Psychol.*, 1958, **10**, 48–55.

QUANTZ, J. C. Problems in the psychology of reading. *Psychol. Monogr.*, 1897, **2**, No. 1 (Whole No. 5).

ROCKETT, F. C. Speed of form recognition as a function of stimulus factors and test anxiety. *J. abnorm. soc. Psychol.*, 1956, **53**, 197–202.

ROSEMAN, M. Closure behavior and levels of personality integration. *J. Pers.*, 1952, **21**, 48–58.

ROSEN, A. C. Change in perceptual threshold as a protective function of the organism. *J. Pers.*, 1954, **23**, 182–194.

ROSENBAUM, G. Stimulus generalization as a function of experimentally induced anxiety. *J. exp. Psychol.*, 1953, **45**, 35–43.

ROSENBAUM, G. Stimulus generalization as a function of clinical anxiety. *J. abnorm. soc. Psychol.*, 1954, **53**, 281–285.

SANDERS, R., & PACHT, A. R. Perceptual size constancy of known clinical groups. *J. consult. Psychol.*, 1952, **16**, 440–444.

SHAW, W. A. Facilitating effects of induced tension upon the perception span for digits. *J. exp. Psychol.*, 1956, **51**, 113–117.

SHORE, M. F. Perceptual efficiency as related to induced muscular effort and manifest anxiety. *J. exp. Psychol.*, 1958, **55**, 179–183.

SILVERMAN, R. E. Anxiety and the mode of response. *J. abnorm. soc. Psychol.*, 1954, **49**, 538–542.

SILVERMAN, R. E., & BLITZ, B. Learning and two kinds of anxiety. *J. abnorm. soc. Psychol.*, 1956, **52**, 301–303.

SINGER, J. L. Personal and environmental determinants of perception in a size constancy experiment. *J. exp. Psychol.*, 1952, **43**, 420–427.

SLATER, E., & SLATER, P. A heuristic theory of neurosis. *J. Neurol. Neurosurg. Psychiat.*, 1944, **7**, 49–55.

SMITH, K. On the inter-relationships among organization, motivation and emotion. *Canad. J. Psychol.*, 1958, **12**, 69–73.

SOLLEY, C. M., & SNYDER, F. W. Information processing and problem solving. *J. exp. Psychol.*, 1958, **55**, 384–388.

SPENCE, K. W., & FARBER, I. E. The relation of anxiety to differential eyelid conditioning. *J. exp. Psychol.*, 1954, **47**, 127–134.

SPENCE, K. W., FARBER, I. E., & MCFANN, H. H. The relation of anxiety (drive) level to performance in competitional and non-competitional paired-associates learning. *J. exp. Psychol.*, 1956, **52**, 296–305.

STENNETT, R. G. The relationship of performance level to level of arousal. *J. exp. Psychol.*, 1957, **54**, 54–61.

STEVENS, S. S. On the psychophysical law. *Psychol. Rev.*, 1957, **64**, 153–181.

TEUBER, H.-L., & MISHKIN, M. Judgment of visual and postural vertical after brain injury. *J. Psychol.*, 1954, **38**, 161–175.

TOLMAN, E. C. Cognitive maps in rats and men. *Psychol. Rev.*, 1948, **55**, 189–208.

WECHSLER, D., & HARTOGS, R. The clinical measurement of anxiety. *Psychiat. Quart.*, 1945, **17**, 618–635.

WELFORD, A. T. *Skill and age: An experimental approach.* London: Oxford, 1951.

WOODWORTH, R. S. *Experimental psychology.* New York: Holt, 1938.

WRIGHT, M. W. A study of anxiety in a general hospital setting. *Canad. J. Psychol.*, 1954, **8**, 195–203.

YERKES, R. M., & DODSON, J. D. The relation of strength of stimulus to rapidity of habit formation. *J. comp. Neurol. Psychol.*, 1908, **18**, 459–482.

(Received October 27, 1958)

OPUS #1

An event of importance for
NEW AUTHORS ONLY

OPUS #1 is the title of a new Philosophical Library 1959 book series which will publish the deserving manuscripts of new authors only.

OPUS #1 has two basic requirements: The author must have something to say and know how to say it.

OPUS #1 will be dedicated to the humanities and will include works in the fields of Art, Literature, Philosophy, Religion, Sociology, History, Psychology and Psychiatry.

OPUS #1 books will be printed on special, fine antique paper, and artistically cloth-bound for library use.

Only complete book-length manuscripts accepted.

Inquire for full details
Philosophical Library, Publishers
Dept. OP-116
15 East 40 St., N.Y. 16, N.Y.

Schizophrenia Manfred Sakel	**5.00**
Epilepsy Manfred Sakel	**5.00**
The Analysis of Dreams Medard Boss	**6.00**
Group Psychoanalysis B. Bohdan Wassell	**3.75**
The Neuroses and their Treatment Edward Podolsky	**10.00**
Psychotherapy and Society Wladimir Eliasberg	**6.00**
The New Chemotherapy in Mental Illness H. L. Gordon	**12.00**
Principles of Self-Damage Edmund Bergler	**6.00**
The New Psychiatry Nathan Masor	**3.75**
Experimental Psychology Ivan Pavlov	**7.50**

Philosophical Library, Publishers
15 East 40 Street, New York 16

THE BRITISH JOURNAL OF PSYCHOLOGY

Edited by BORIS SEMEONOFF

Vol. 50 Part 1 February, 1959 20s. net

BENBOW F. RITCHIE. Explanatory powers of the fractional antedating response mechanism.

H. TAJFEL. Quantitative judgment in social perception.

C. H. BAKER. Attention to visual displays during a vigilance task. II. Maintaining the level of vigilance.

J. D. KEEHN. Increase in perceptual sensitivity as a function of learning in the test situation.

PETER McEWAN. Figural after-effects, retinal size and apparent size.

VERNON HAMILTON. Eysenck's theories of anxiety and hysteria—a methodological critique.

H. J. EYSENCK. Anxiety and hysteria—a reply to Vernon Hamilton.

J. C. RAVEN. Note on Burt's 'The distribution of intelligence.'

U. T. PLACE. The 'phenomenological fallacy'—a reply to J. R. Smythies.

PUBLICATIONS RECENTLY RECEIVED.

OTHER PUBLICATIONS RECEIVED.

The subscription price per volume, payable in advance, is 60s. net (post free).

Subscriptions may be sent to any bookseller or to the

CAMBRIDGE UNIVERSITY PRESS

Bentley House, Euston Road, London, N. W. 1

The Psychology of Early Childhood

by Catherine Landreth, University of California

"Especially useful for those searching for a *complete* and well-documented text or reference dealing with the early years of life."—*Dorothy Giddings, Simmons College*

"The tables and pictures are well-integrated into the text so as to add great lucidity to the book. I cannot help being impressed by the vast store of dynamic information and humanistic appreciation of children that Dr. Landreth has at her disposal. This is an excellent college textbook and should be beneficial to most classes in child psychology."—*Paul T. King, Michigan State University*

"This is an excellent survey of early child development. The charts and tables are well chosen to supplement the text. Another desirable feature is the list of thought-provoking questions that precede each chapter."—*D. Leton, University of California at Los Angeles*

". . . an outstanding contribution to the literature and should be widely read. I am impressed by the author's scholarship and attention to details; yet she has organized those details in such a manner as to make for interesting reading. The book is exceptionally well illustrated."—*D. Bruce Gardner, Iowa State College.* 758 pp., Illus., $6.50 text.

ALFRED A. KNOPF, *Publisher*

College Department 501 Madison Avenue New York 22

Studies in Mathematical Learning Theory

Edited by ROBERT R. BUSH and WILLIAM K. ESTES. This integrated collection of research papers considers the most recent developments in the analysis and application of mathematical learning theory. *Stanford Mathematical Studies in the Social Sciences, III.* $11.50

The Psychology of Affiliation

EXPERIMENTAL STUDIES OF THE SOURCES OF GREGARIOUSNESS

STANLEY SCHACHTER. In a series of masterly experiments, the author has probed deeply into the ways in which states of emotion and anxiety affect affiliative needs. *Stanford Studies in Psychology, I.* $3.75

The Gifted Group at Mid-Life

THIRTY-FIVE YEARS' FOLLOW-UP OF THE SUPERIOR CHILD

LEWIS M. TERMAN and MELITA H. ODEN. This is the fifth volume in a series which has become a landmark in the identification of superior mental ability and of the factors that put it to effective use. *Genetic Studies of Genius, Vol. V.* $4.50

Stanford University Press Stanford, California

L. L. Thurstone

THE MEASUREMENT OF VALUES

With a preface by Thelma Gwinn Thurstone

L. L. Thurstone was one of America's outstanding psychologists, known for his studies of psychological measurements and for his application of precise measurement techniques to the psychological and social sciences.

Here are 27 of his most noted papers, arranged in five groups—learning, scaling, psychophysical measurement, attitude measurement, and multiple factor analysis. Each group is introduced with a brief discussion of the controversial issues current when the papers were published. The volume also contains a bibliography with a list of 95 Psychometric Laboratory Reports, a list of available microfilms and a partial list of psychological tests. $7.50

Through your bookseller

THE UNIVERSITY OF Chicago PRESS

Chicago 37. In Canada: *University of Toronto Press, Toronto 5, Ontario*